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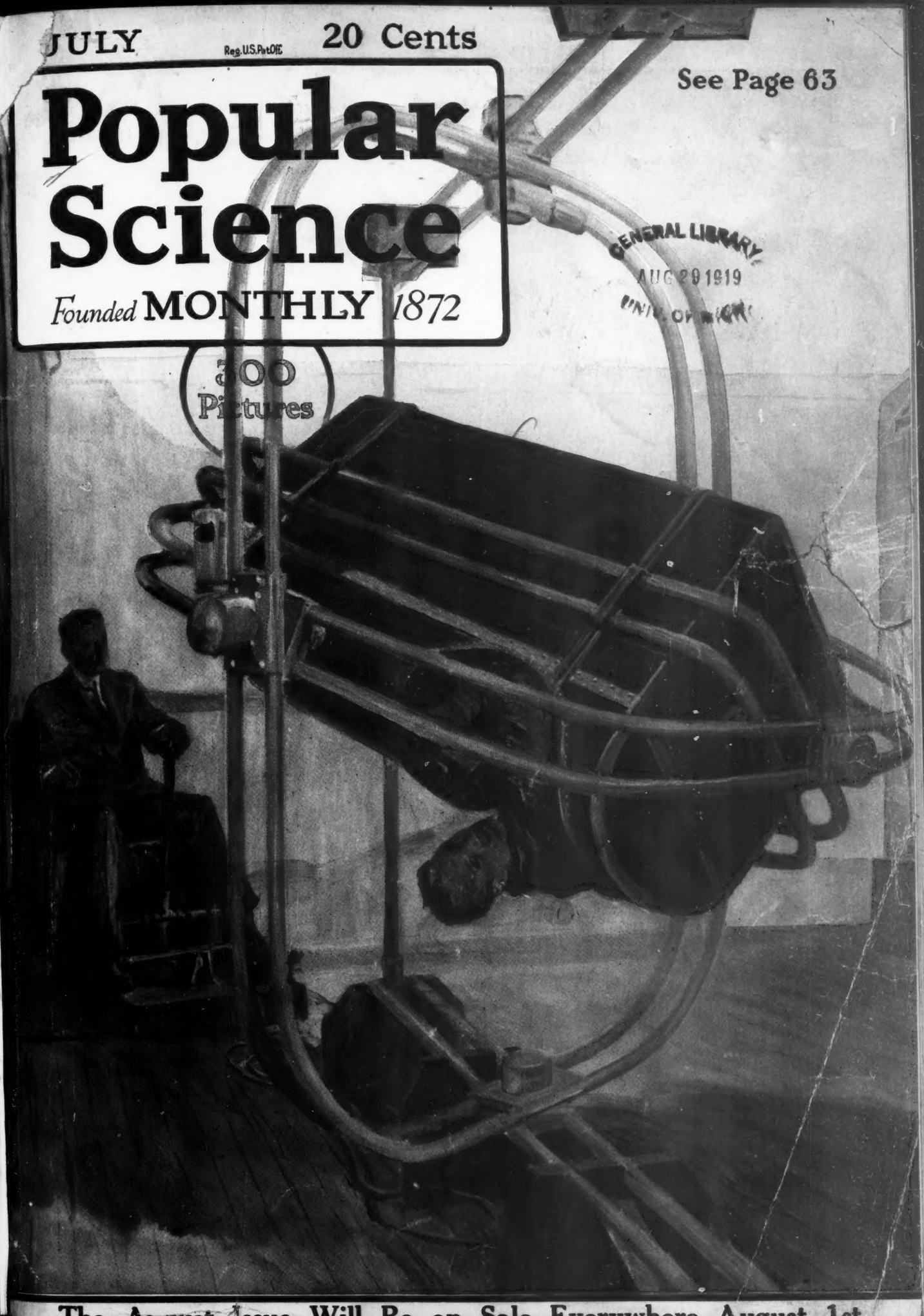

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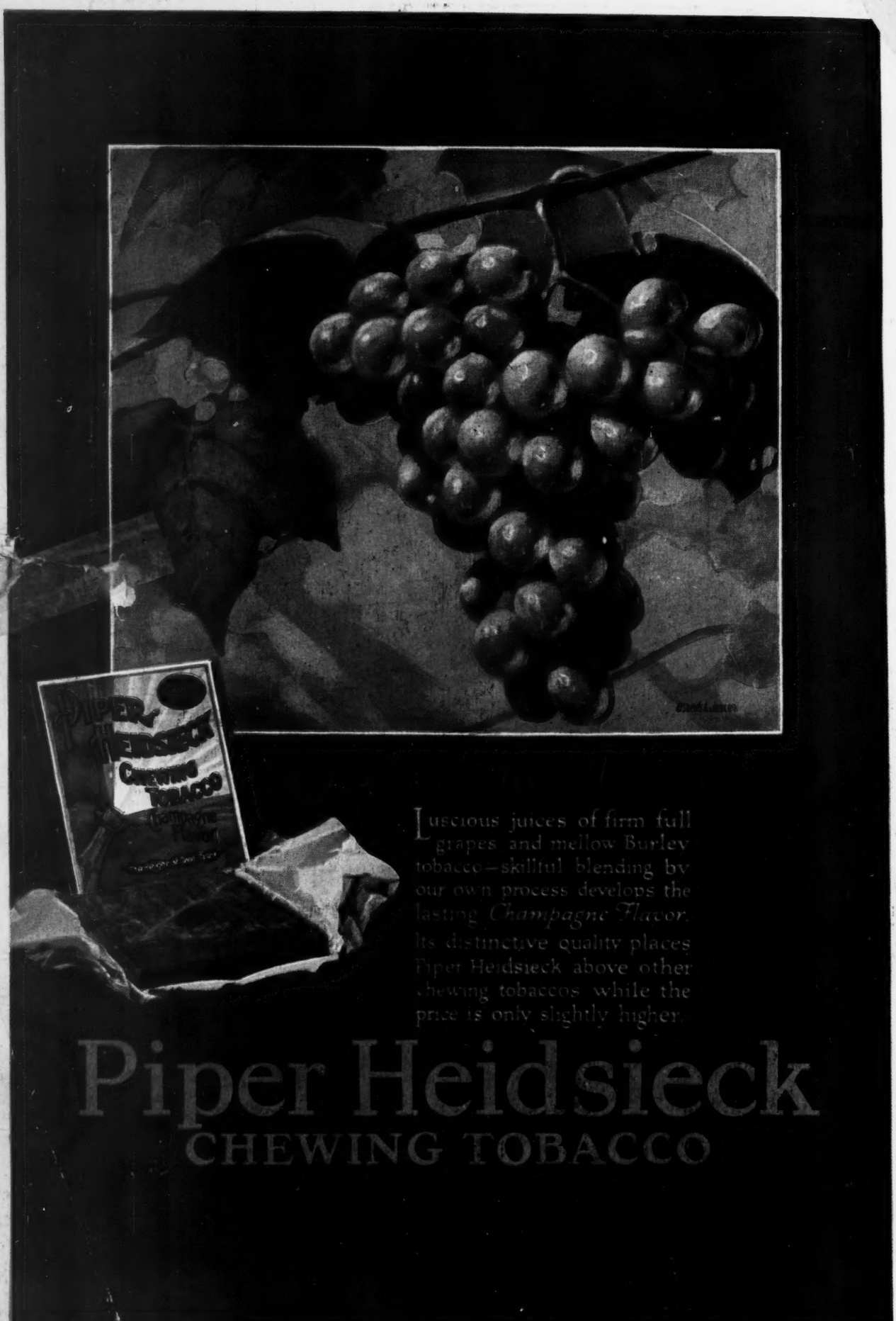

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Popular Science Monthly

Waldemar Kaempffert, *Editor*

July, 1919; Vol. 95, No. 1
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Fighting an Oil-Well Fire

It's a case where "Water, water, quench fire," doesn't work

By P. Schwarzbach

SUDDENLY, without warning, there was a loud crash, and a flaming automobile shot up into the air. This happened as the automobile was crossing a bridge over a creek in Drumright, Oklahoma.

What caused the accident? Near the creek was a flowing oil-well. Gases from the well had collected along the edge of the creek, and the headlights of the onrushing car had exploded them. Gas and oil will burst into flames at the toss of a spark, and even, as this case proves, from the heat of a head-light. And these fires are the hardest of all fires to fight. Water will not quench them—they must be smothered.

Imagine trying to smother 100-foot flames shooting out of an immense gas-tank. This is one of the problems that harrow the souls of the owners of oil and gas wells and tanks.

In combating gas and oil fires, the fighters have tried suffocation by steam and by foam. The foam is made by bringing together two chemical solutions that produce tough, non-inflammable bubbles. They have also tried cutting off the source of supply by digging a tunnel up to the well and then forcing the oil to flow into it.

Oil was flowing from a well in Humble Field, Texas. It was pouring out of two pipes—one twenty feet

A group of men advanced toward the burning well, shielded from the flames by a piece of corrugated iron; in their hands they carried a long pipe with an asbestos-lined cap at the end

363584

long lying on the ground, and the other an upright one measuring six feet. At the same time a man was mending a broken power line on the floor. A spark!—and flames shot out of both pipes.

How did they tackle it? In the first place, they chopped down the trees near by. Next they sent for all the boilers and pipes in the vicinity, and in the meantime built around the well a circular levee one hundred feet in diameter and three feet high. Then they dug a ditch in line with the flaming pipe on the ground and placed a slice of smokestack in its mouth. The other end of the ditch terminated in a circular depression some distance away. Then they contrived an iron cover for the ditch. When all was ready, a group of men advanced toward the well, each man carrying a shield of corrugated iron. Water was played on them continually.

A funnel-shaped pipe riveted to a smokestack was sent by wire to the blazing well. It was lowered over the fire, funnel end first; the flames shot up the smokestack, which was promptly removed. With no gas to feed on, the fire went out

Smothering the Flames

They carried a long pipe with an asbestos-lined cap at the end. They fitted the cap over the top of the upright oil-pipe, and its flames were smothered. Then the water and steam from the boilers were turned on the pipe on the ground, and its flames were forced down the smokestack at the head of the ditch. It was all over in fifteen minutes—but it took fifteen hours to get ready.

A gas-well caught fire in Tulsa, Oklahoma. It was inconveniently located in a river-bed. The fire-fighters stretched wire cable from bank to bank, so that it passed alongside the flaming well. Then they riveted a funnel-shaped pipe to a smokestack, attached it to pulleys on the wire, and started it off just as if it were a parcel basket on a department-store trolley. As the smokestack reached the scene of the fire it was gradually turned until the funnel fitted over the blaze.

The flames rushed up the smokestack and came out at the top, whereupon the smokestack was promptly removed, and with it the flames.

An Ounce of Prevention

Are these well fires due mainly to carelessness—workmen dropping lighted cigarettes and matches? No—to electricity: both the electricity of lightning and static electricity. The reason that lightning strikes so often in oil- and gas-well districts is that inflammable gases, which have escaped from the wells, fill the air. To prevent lightning fires, prevent the wholesale escape of gas.

You rub your feet on the carpet and light the gas with a spark from your finger. What causes the spark? Static electricity.

When you fill a can with oil, the friction of the oil against the can generates static electricity. If the can is not touching some conductor, the electricity it is storing up will have no outlet. When it has more than it can stand, a spark will jump from it to the nearest piece of metal. One spark is enough to start fire. Therefore a good rule to follow when working on wells is let metal touch metal whenever possible.

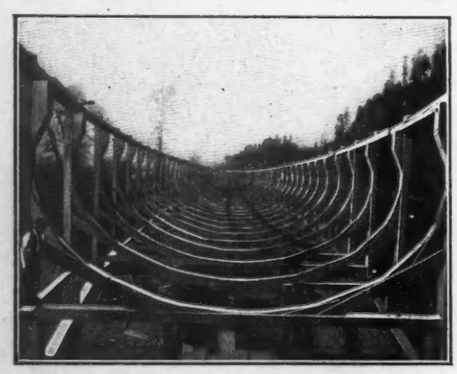
Locked in the Cradle of the Raft

WHAT happens to the murmuring pine and the hemlock when war is declared? Many of them cease murmuring, for they are chopped down and sent off to help make ships, airplanes, and the many temporary structures that the work of war demands.

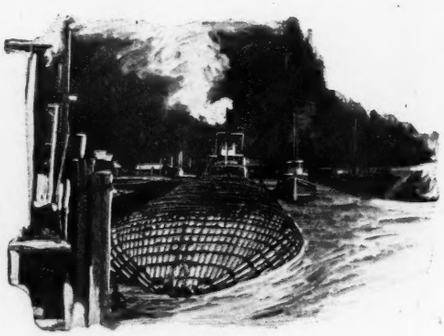
When the chopped-down trees have been turned into logs they are sent down the river in huge rafts of their own making. Each raft contains millions of feet of lumber. Here we see how these rafts are made in Oregon, which is one of the greatest lumber States in the country.

First a large cradle is constructed. It looks much like the framework of a big ship minus a keel. Then the logs are fitted in; they are held in place by many heavy chains. Powerful ocean-going tugs tow the finished raft away. Throughout the voyage the logs are carefully watched lest they start to slip. This is not surprising, for each raft is worth a fortune.

The forests of Oregon cover more than half the area of the entire State, government reports tell us. There you find—besides pine and hemlock—cedar, spruce, oak, ash, maple, mahogany, and fir trees. The Douglas fir is most abundant, constituting five sevenths of all the trees in the State.



In the great lumber state of Oregon rafts are made in huge cradles. Each cradle, which looks much like the framework of a ship, contains millions of feet of lumber



The finished raft is towed down the river by powerful ocean-going tugs. The logs are closely watched for any sign of loosening, for a raft of this sort is worth a fortune

Spotting and Trailing Submarines by Sound

By Ernest Welleck

ON March 16, 1918, the French destroyer *Dunois*, under the command of Lieutenant Terreaux, was zigzagging in the Channel between France and Great Britain, searching for German submarines. Shortly before one o'clock in the afternoon, a British hydro-airplane, flying over the *Dunois*, signaled that a hostile submarine was in close proximity. A listener was sent to the listening-chamber.

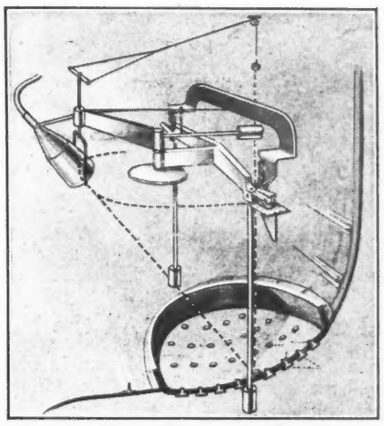
Twenty minutes later the listener reported the sound of an explosion, probably the discharge of a torpedo which had missed the destroyer. By means of the hydrophone, or listening apparatus, with which the *Dunois* was equipped, the listener was able to ascertain the direction from which the sound of the firing had come, and the destroyer immediately started in pursuit of the submarine.

A French Lieutenant's Invention

Shortly before half past four the listener reported to the commander that the *Dunois* had caught up with the fleeing submarine and was right over it. A depth-bomb was dropped. This exploded forty seconds later, and the submarine was disabled and soon after sank.

The hydrophone, the invention of Georges Walser, a French naval lieutenant, had stood its test, and the French government equipped a large number of destroyers with hydrophones of the Walser type. Their success was remarkable.

On each side of the submarine destroyer, well forward and near the keel, large lens-shaped patches of steel, bulging outward, are set over holes cut in the hull for that purpose. These patches have many perforations, which are closed by sensitive vibrating plates. The patches form large microphones, which collect the sound waves traveling through the water and transmit them to a receiving instrument in the interior of the ship. The receiving apparatus is placed in a sound-proof chamber extending from one side of the ship to the other between the two microphones.

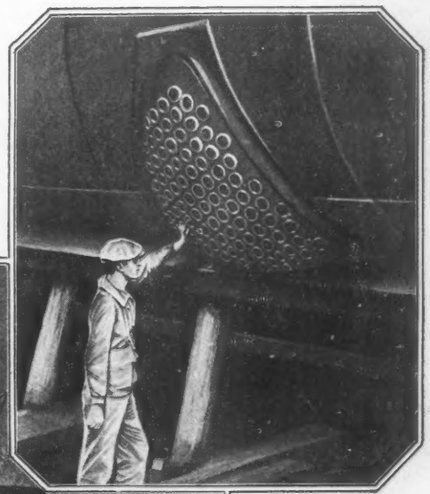


In the lower part of this diagram is shown part of the lens-shaped patch of the hydrophone. The little dots are microphones, the sound from which is focused in the dotted curve shown in the middle of the diagram. The listening-funnel, which is supported by an ingeniously designed bracket, is attached to a hinged arm in such a manner that its opening always points toward the center of the patch, while it can be moved to any point of the dotted focal plane by means of a pulley rope around the disk below the hinge of the supporting arm. The difference in the intensity of the sounds transmitted by the microphones enables the listener to determine the direction from which the sound comes

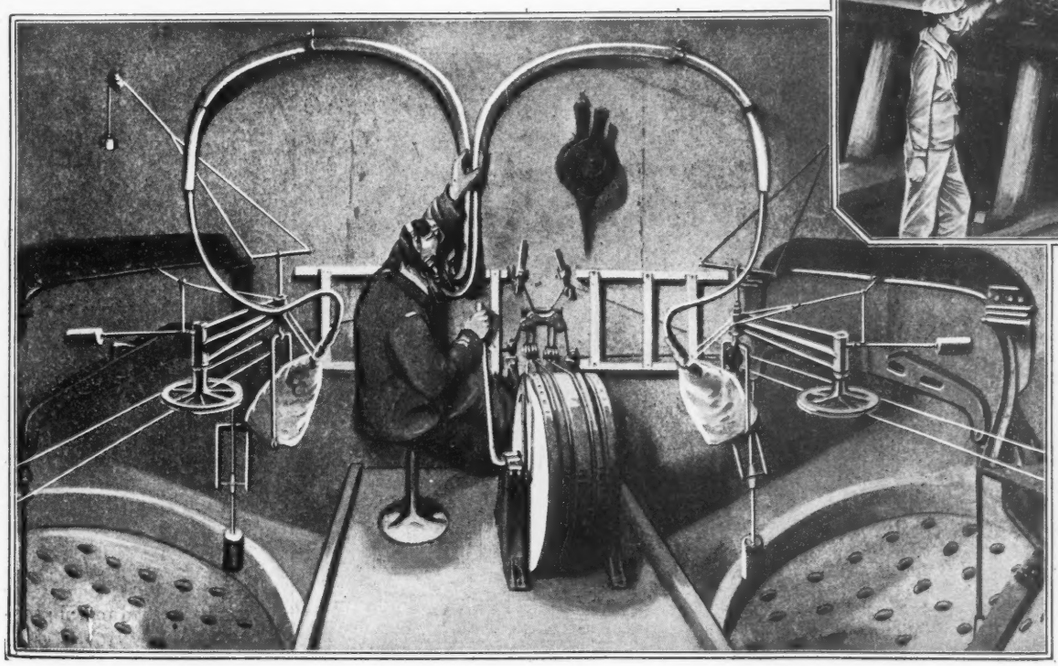
A Wonderful Apparatus

Each apparatus includes a sound-collecting funnel, which is held by a rotatable arm in such a position that the opening of the funnel points to the center of the microphone, while it moves with the arm in a circular plane within focal distance of the microphone.

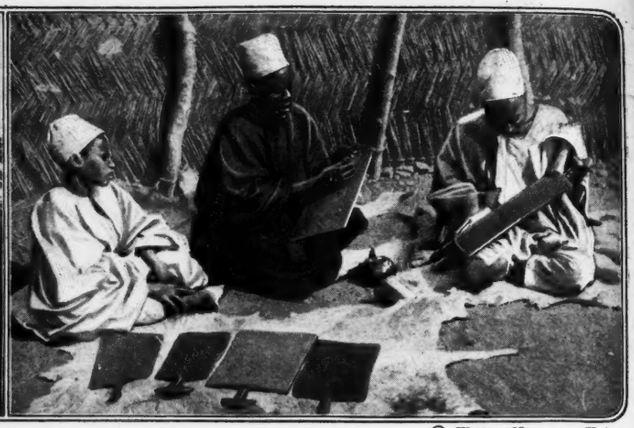
A pulley arrangement enables the operator to move the sound-collecting funnels at will to any part of the circumference of the microphones. The sounds collected by the funnels are transmitted by flexible tubes to the listener's ear-pieces. The listener moves the funnel to the point where the sound can be heard most clearly, and the marks of the scale on the rim of the microphones, corresponding to the position of the funnel, give him the direction whence the sound-waves come. The distance between the ship and the source of the sound is calculated from the vibrations.



There is one of these blister-like patches on each side of the destroyer or chaser that is equipped with the Walser hydrophone



In a sound-proof cell a listener catches every murmur and by turning the handle of the drum he moves the listening-funnels to different points in the focal plane



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California's Latest Attraction—Mud Geysers

ON the eastern shore of Salton Sea, California, a field of mud geysers recently came into existence. The field spreads over a little more than two acres. The geysers are various-sized caldrons of hot mud.

Until fifteen years ago this sea was a dry, salt-incrusted area with a maximum elevation of 265 feet below sea-level. In the year 1904 the Colorado river ran over its banks, and the water entered into the basin, making a lake of 400 square miles. This inflow was stopped in 1906, and since then the Salton Sea has been shrinking. The geysers appeared a short time ago—caused, presumably, by earthquakes in the vicinity.

All the News that's Fit to Print in Bano

THE man in black is the editor of the Bano daily newspaper of Bano, Africa. At his left squats his first assistant, and at his right the office-boy.

This African editor does not have to worry about circulation, printers' strikes, the high cost of paper, and similar editoral troubles.

When he gets a piece of news, he smooths off some slabs of wood, writes up the story in his best editorial style, and then gives the slabs to his office-boy, who runs off with them and hangs them in conspicuous places so that he who runs may read. The only trouble with this system is that nobody makes any money.

The Début of a Dirigible

IN our picture the R-33 is about to make her début. The signal has been given, the doors are being opened, and she will presently step forth.

It takes fifty men twenty minutes to open these doors by means of winches, for the doors are very large. But they have to be, since the R-33 herself is a monster. She is the largest airship in the world.

This début of hers took place at Barlow, England, on March 6. She went up to a height of 2,000 feet and stayed up there three hours before she came down again.

She was so well satisfied with her flying ability that she has decided to make an effort to win that $50,000 prize to be awarded for crossing the Atlantic first.

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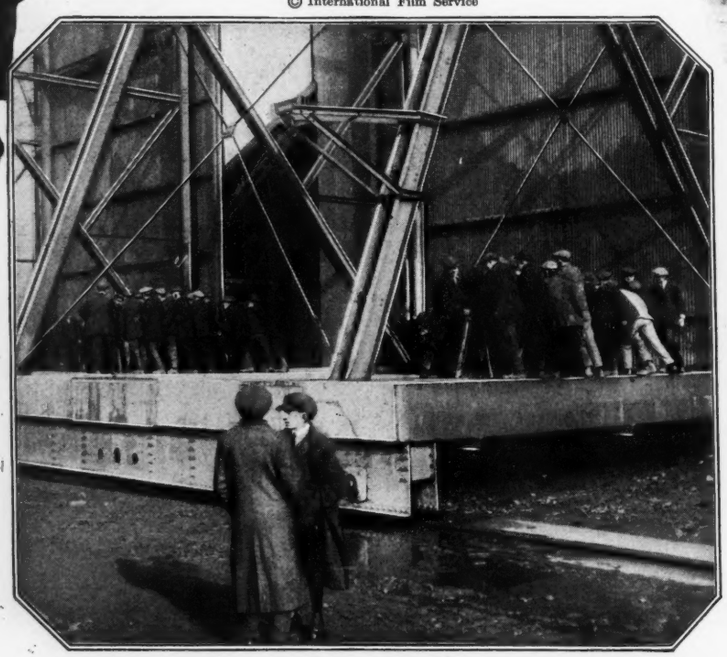


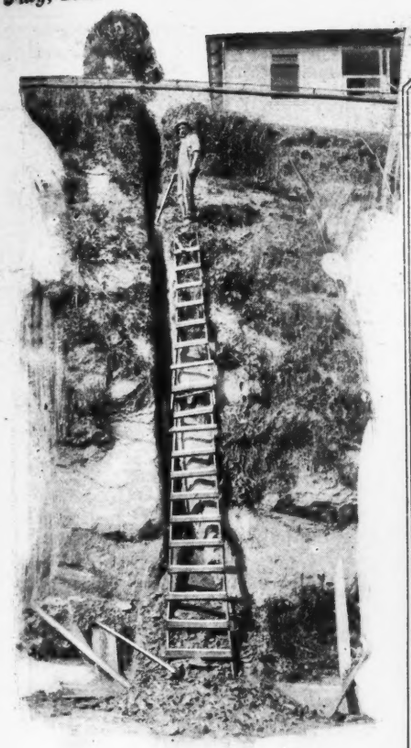
Our Capital's Public Waste-Baskets

THE Sixty-fifth Congress filibustered to death a bill for street-cleaning Washington. Now, though Congress doesn't object to dirty streets, the Washingtonians do. When the waste papers began to pile up in the streets, the natives were dismayed until one of them thought of using the wire protector of a tree as a scrap-basket. Now they all do it, and the streets are cleared temporarily at least.

Making Use of the Dead Ones

HE who stands on the ladder with an oil-can in his hand once owned a saloon where he sold champagne. As the "empties" increased too swiftly for his cellar's capacity, he started to build a monument of them.

Each circular layer contains eighteen bottles, arranged bottoms out, with lights in the center. Recently the champagne-seller wisely decided to sell gasoline, and turned his saloon into a garage. He uses the monument as a pump.



'Twas an Irishman's Idea

AN Irish plumber had to climb a 30-foot ladder to dig a ditch, and, to be sure, he's talking about it yet.

The explanation of the feat is simple. The ditch was dug for a sewer-pipe which was to run from a house on a hill to the street forty feet below. The hill was so steep that had the plumber tried to walk up and down it very often he would surely have slipped and fallen. Rather than risk it, he used a ladder.

The ditch is finished, and the plumber is still whole.

A Toy-Maker of China

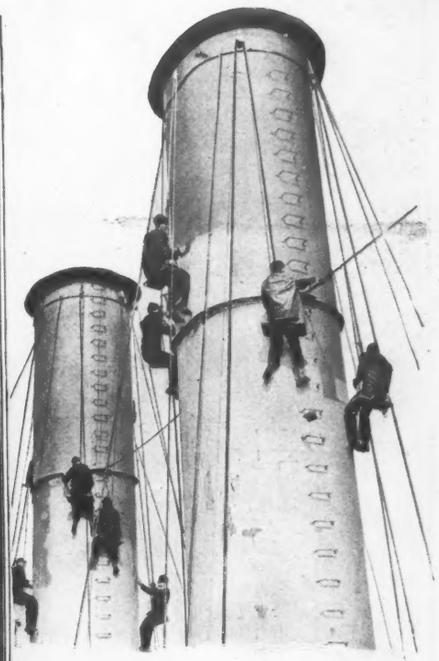
THIS smiling fellow who is all dressed up in a pair of trousers and a piece of padding is not the tramp he looks. He is a Chinese manufacturer—a maker of toys. He made all the toys on his stand, carving them out and painting them by hand.

Besides being a manufacturer, he is a salesman. After he has made his toys he peddles them through the streets of China. As a result he is able to sell them for practically nothing.

China has no toy factories, and so Chinese children must content themselves with carvings like those shown in the picture. But if Chinese children are like American children, they will love best the dirtiest, crudest, ugliest toy they own.

The Tale of a Totem-Pole

HERE is our story of a totem-pole. The knock-kneed fellow at the foot of the pole is the chief. But how about the dangling child? He is undoubtedly the chief's son (note the resemblance), and he has died. But why this special notice? Perhaps his father killed him—hanged him or scalped him! There we have it. Unnatural father! No wonder he looks so queer.



Back to Peace Paint

ONCE the stacks of this cruiser were striped and blotched to make her hard for an enemy to look at. Camouflage was one of the most picturesque things the war brought, but already the word is slipping from the common speech and our warships are putting off their weird motley for new spring coats of peace paint.

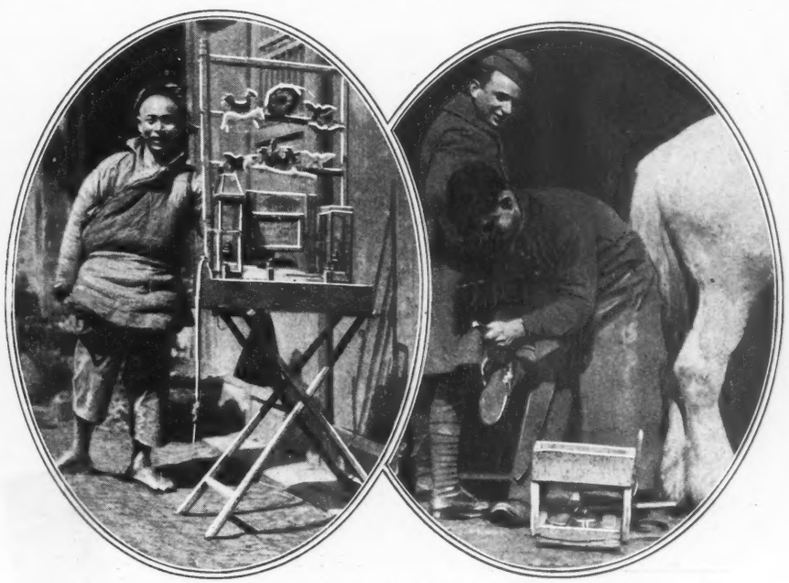
Swung high in bo'sn's seats, the bluejackets are changing the funnels back to their conventional gray. The painters start at the top of the tall stacks, and are lowered from time to time as they finish the sections within their reach.

Hold Up Your Hoof

GO to the blacksmith with your run-down heels and get shod like a horse. Horseshoes are both strong and lucky. Of course they are made of iron and are consequently noisy, but they last much longer than the very poor leather of today.

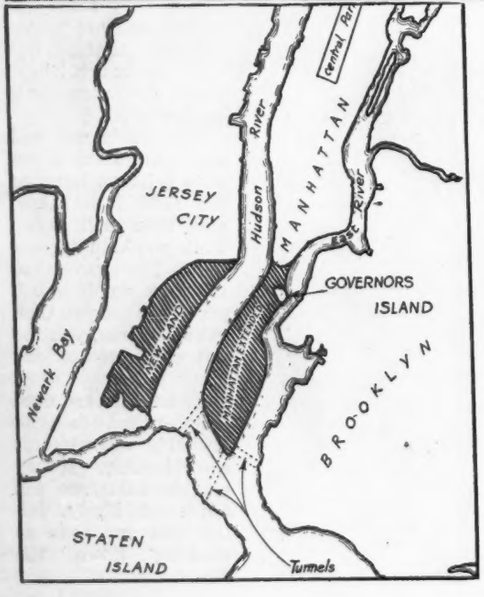
The blacksmith will treat you just as if you were a horse, hammer the shoe into shape, and then nail it on while you hold up your foot. The chances are that he would much prefer to shoe you than a horse, since you are not so liable to kick him.

Ex-soldiers are used to hob-nailed boots and probably will welcome cheap heeling. If they get the habit, we will all, most likely, follow suit and soon go clinking down the street.



There is not a roof on Manhattan Island large enough for airplanes to land on. The passenger-carrying airplanes of the near future will require an open space of at least a mile square. Dr. Thomson's plan for New York city is the reclaiming of about four square miles of land between the Battery and Staten Island, and the construction thereon of huge terminal buildings to accommodate steamships, motor-trucks, and airplanes. He estimates the cost of this new city at $100,000,000

Redrawn from a picture © by Success Postal Card Co.



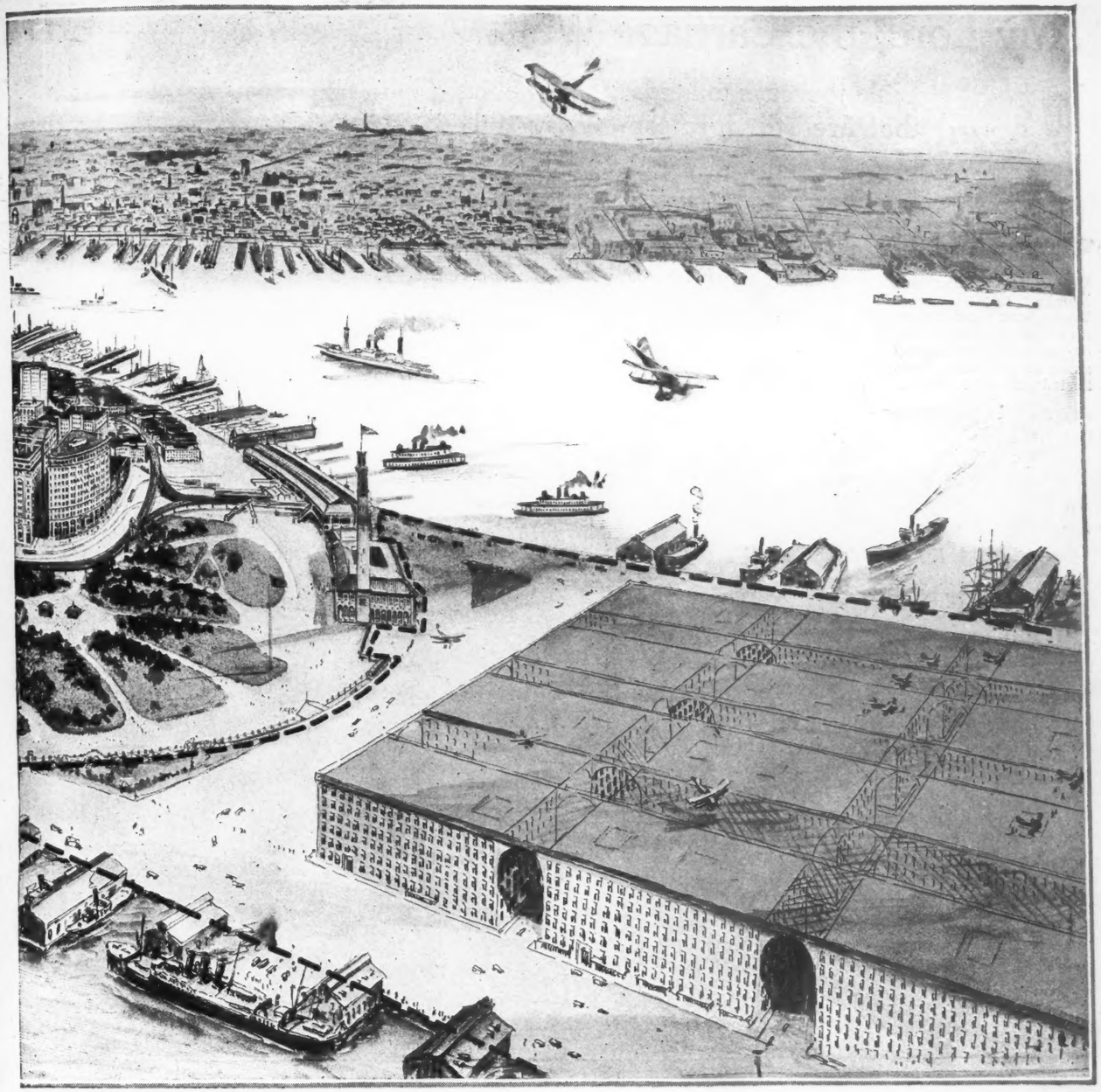
A Plan to Extend New York

By Dr. T. Kennard Thomson,

[*Dr. T. Kennard Thomson, whose daring plan for making New York a great port for airplanes is published here, is an acknowledged authority on pneumatic caissons. He has been retained as consulting engineer in the construction of many New York skyscrapers, and has built pneumatic caissons for important bridges over many of the larger rivers. He was one of the board of five engineers in charge of the construction of the New York Barge Canal.*—THE EDITOR.]

THE problem of the automobile is roads; that of the airplane, landing-places. And, just as good roads have followed the invention of the automobile and the automobile has multiplied with good roads in a never-ending succession, so airplanes in commercial use will multiply with properly laid out chains of landing-places and the landing-places will multiply with the demand of the airplane.

At present the location of landing-places is controlled by circumstances. Mineola, set in the plains of Long Island, becomes the airplane port of New York. But it is as if ships coming to New York had to dock at Sandy



to Make a Great Airplane Port

Consulting Construction Engineer

Hook and leave their passengers to make their way to the city as best they could. It frequently takes the passenger or the mail package coming by airplane from Washington to New York longer to reach Manhattan after landing on Long Island than it did to fly from the capital to the landing-place.

Wanted, then—a good landing-place in Manhattan. That means a smooth surface about a mile square. For at present the most favored types of airplanes have to run for about a thousand feet along the ground before taking the air, and, having to land at one half their maximum speed, they need space in which to settle down to earth again.

There is, of course, no such space to be had at present on Manhattan Island. Central Park is sacred as the city's one big breathing-space, and anyway it is not suited to the purpose. The answer, then, is—build such a place. My plan is this:

Build a great station for airplanes, steamships, barges, and motor-trucks by extending Manhattan Island at the Battery. It can be done for $100,000,000, and the land thus reclaimed would be worth many times that amount, for it would create a new city of some four square miles.

My idea for a Manhattan extension is to construct a sea-wall from the Battery toward Staten Island in such a way that the new Battery will be about the same distance from Staten Island as the present Battery is from Jersey City, and to reclaim the space between these sea-walls—more than four square miles.

Wherever rock is near the surface the space between the sea-walls, or coffer-dams, will be pumped out; but where the rock is more than sixty or seventy feet from the surface, the space will be filled with sand pumped in through a suction-dredge having a capacity of 50,000 cubic yards per day.

Eventually adequate landing-places will be built on top of the buildings of the new city. The buildings will cover entire blocks, and will be narrow enough to make air-wells unnecessary. These blocks can be any length—1,000 feet, one mile, four miles. There will be arcades at the street level, say every hundred feet.

My Lord, the Carriage Waits

Little journeys to lands that are still fordless

© E. M. Newman

Not a straw man, but a Chinese jinrikisha runner ready for a rainy day: the straw hanging from him is his raincoat

Cotton is the secret of Bombay city's success. Throughout the city there are many cotton-mills; and ox-carts are constantly going to and from them, loaded with bales of cotton

© Brown & Dawson

© E. M. Newman

The dog-sled of the north is slowly giving way to the motor-sled; motor-sleds are now used in Alaska for carrying mail

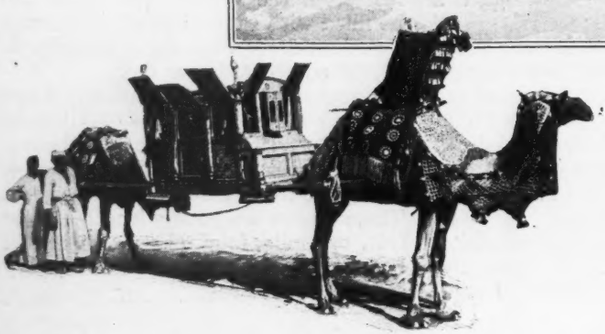
Photograph by Brown & Dawson

© E. M. Newman

Llamas, the pack-animals of South America, will carry a load of exactly one hundred pounds; one pound more and they will lie down never to rise until that extra pound is taken off

© E. M. Newman

The only time we carry a man on our shoulders is when he has won a game. A Japanese does not need to win a game: he need only have the price of a sedan-chair and four servants



© Publishers' Photo Service

The Egyptian lady sits in a coach that sits on the neck of a camel. What would happen if the camel ducked?

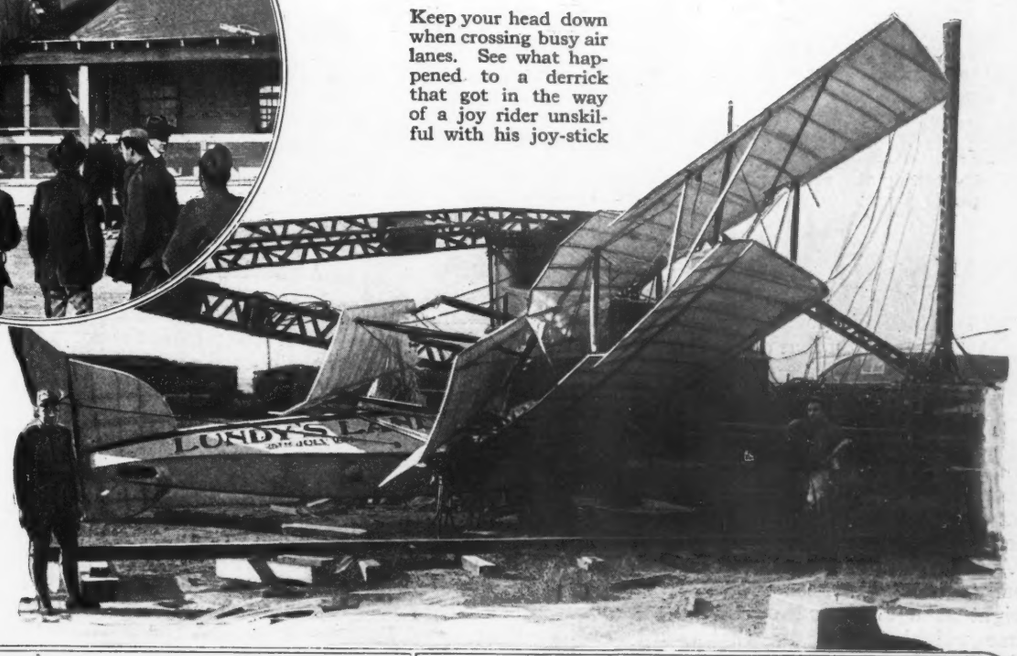
© Newman Traveltalks and Brown & Dawson

The Chinese enjoys the shade of his front porch while he drives his donkey-power express!

Look Out for the Airplane!

Why we may soon be in need of new safety-first signs

Keep your head down when crossing busy air lanes. See what happened to a derrick that got in the way of a joy rider unskilful with his joy-stick

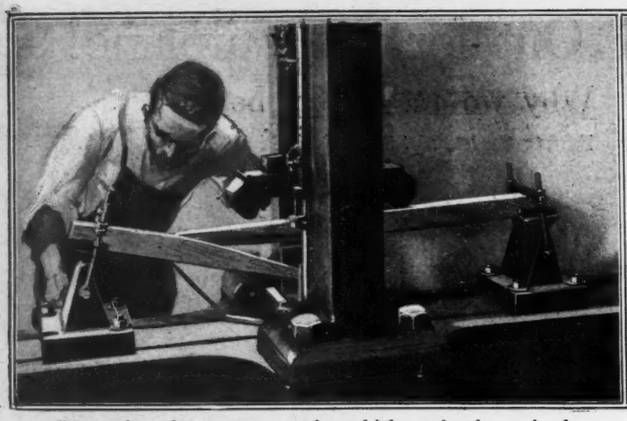


"Hit by an airplane," headlines the London *Telegraph*, with true British reserve, considering that two men driving along a country road were killed in a collision with a low-flying airplane. The machine above smashed into an electric-light pole before standing on its head on the roof

The automobilist has been having things his way long enough. Now, as he hears the roar overhead, he knows how we feel when we scuttle out of his way in our Ford. This driver wasn't quick enough, and the airplane got him

Cow on the track! Landing-places are to airplanes what good roads are to the automobile. Until we have well planned series of landings, a 'plane is apt to drop down in anybody's pasture—and up goes the price of milk

Disputing the crossing with the fast freight, the airplane broke its nose against its sturdier earth rival, but it did it so much more impressively than an automobile does it that the line was blocked for half an hour



By testing the pressure under which variously grained woods break, unusual weaknesses are accounted for

The stick snapped because the grain slants to one side. It is as weak when spirally grained, as shown at the left

Why Baseball Bats Break

CRACK! You rise from your seat in the grand-stand. You feel certain that the ball is going into the bleachers, at least.

Instead of that, you see the horsehide pop up in a measly little fly right in the short-stop's hands! The batter broke his bat—that was why it sounded so loud. As he ambles half-heartedly in the general direction of first base, you see him disgustedly chuck the willow to one side.

A baseball bat will sustain nearly three times as much weight as a steel rod of the same weight. Why did that infantile attempt at a hit have to break it?

The reason lies in the fact that the defective bat was either spiral- or diagonal-grained. Unless the stress on any stick of wood is exerted cross-grain, the wood gives way weakly. Stronger than steel in one direction, it is weaker than corn-cobs in the other. Though the bat looked perfect, it contained a fatal defect. The manufacturer could have told this before the varnish was applied, but not afterward.

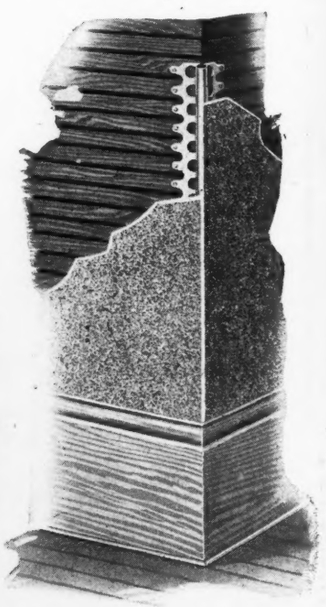
The Forest Products Laboratory at Madison, Wis., discovered this defect in wood. In the course of its work with Sitka spruce and Douglas fir for I-beams and struts in the Curtiss-De Haviland airplane, the experts at the laboratory discovered certain finished pieces of wood to be unaccountably weak. It was found that spiraling of the grain or its slanting to one side was responsible, and in the specifications drawn up experts stipulated against a pitch of more than one millimeter in twenty for stressed parts of an airplane.

Beads to Protect Corners

WHEN one room has a cupboard, the space for it is often stolen from the room next door. The result is that the cupboard's back, having at least one sharp corner, is bound to protrude. The corner is bumped and often broken.

To prevent this it should be strongly made. A metal corner bead is the best protection. It should be nailed to the wooden lath before the coat of plaster is put on. Then, when the plaster is applied, the tubular edge of the bead should not be covered, but should protrude beyond the plaster to withstand all hard knocks.

The bead shown here is a good-looking one and might readily be attached to the outside of a finished wall, as would be necessary if the wall were made of tiles or cement blocks.



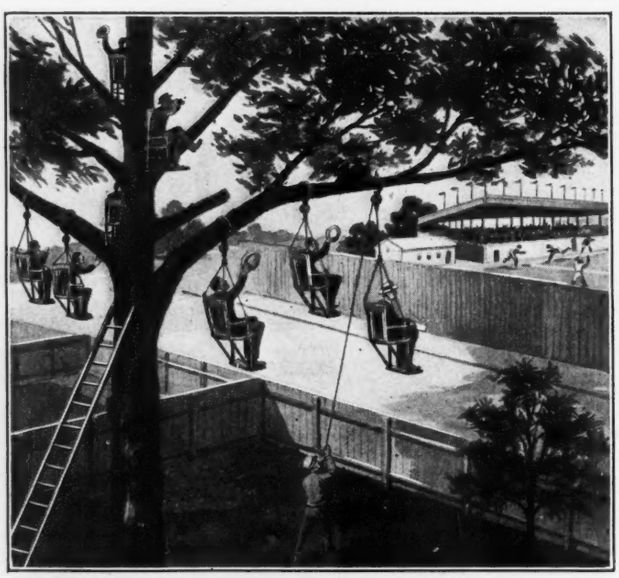
The tubular edge of the bead stands out even after the plaster has been applied

A Tax on Seats in Trees

THE long arm of the law reaches everything—even apple-trees. There was a man who owned a garden in which there was a tree that overlooked a ball-field. Every time a game was played, the man who owned the tree brought out eight chairs and a ladder. He fastened the chairs to the tree and then charged admission, five cents for some seats, ten cents for others, making fifty-five cents on each game.

Now, the Bureau of Internal Revenue heard about that fifty-five cents, and after due deliberation decided that it should be taxed because it came under the head of Admission to Places of Amusement.

Whereupon the price of the seats was raised to six and eleven cents, so that the tree might yield up its eight cents tax whenever a game was played.



If you pay to sit in an apple-tree to watch a ball game you must also pay a war tax, says the Bureau of Internal Revenue

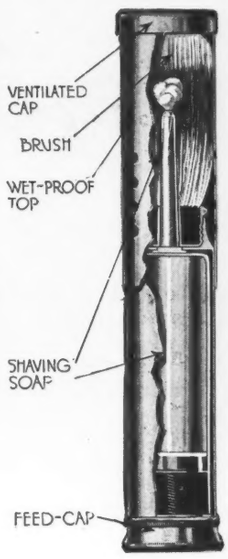
The Baby Can't Lose This Shaving Soap

A BRUSH that carries liquid soap in its handle is the latest help for the man who shaves himself.

The bristles, which are rubber-set, may easily be removed for sterilization, and a wet-proof ventilated cap keeps the damp bristles from soiling clean clothes when the outfit is carried in a traveling bag.

To use it the owner simply dips the brush in water, turns the cap until it clicks once,—announcing that a sufficient amount of soap has been driven into the brush,—and applies the brush to his face.

It is claimed that the handle holds enough cream soap for sixty shaves.



Formula for a good lather: dip brush in water and turn the cap just once

Low tide is harvest time for the barnacle man

Ever Eat a Barnacle?

THE barnacle, pest of the sea, has been revealed in a new light which may be the occasion for a long blast on the horn of plenty. Marine chefs at Long Beach, Cal., have found that it is delicious and nutritious, and are converting it into a soup declared to be as good as clam chowder. Already it has become a favorite in many cafés and even in the highest-class tourist hotels of the Pacific Coast city which brought it out. Credit for its discovery is given to Ulpiano Larco, a cook known for years to seafaring men and familiar with all sea growths. Food experts say the barnacle has remarkable food values, being rich in protein and salts.

Canning concerns are preparing to conserve the barnacle in great quantities, and a big industry is in sight, according to people who are familiar with the situation. Long Beach apparently is the Pacific center of the barnacle world, receiving more of the product than any other coast point. On the piling of the Pine Avenue pier are more than a hundred tons of these, as well as mussels and similar creatures. They are all now being stripped off, and will no doubt be eaten in the form of delectable soups.

Already plans are being made to contract for the barnacles removed from the bottoms of vessels that go into dry-dock at the Long Beach shipyards, and these hitherto scorned and lowly sea denizens will find their way into cans. The methods of preparing them in edible form are not disclosed, but the mussels generally associated with them in growth are also used.

It's an Emergency Coat

HERE is a five-pieced emergency coat designed by Mr. Felberbaum, a Baltimore tailor, as a safety garment for injured soldiers or civilians. Its distinguishing characteristic is that the various parts of the coat are pieced together by metal eyelets and shoestrings.

If the wearer of this garment should desire to detach a sleeve, he need only cut the string that holds the sleeve at the shoulder, and pull off the sleeve. Should he wish to dispense with one half of the coat, he simply cuts the string at the back of the collar.

The inventor of the device claims that this coat can be dissected in less than a minute, without slashing or cutting the garment. He also declares that the coat of detachable sleeves and back will save lives in case of emergency.

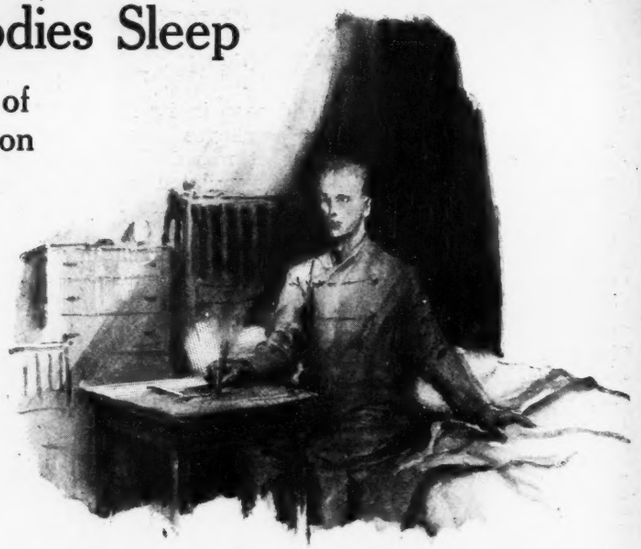
Mr. Felberbaum obtained a job as messenger in order to get into the patent office and other government quarters for the purpose of boosting his invention. His deep-laid plan is to skip hurriedly into an office, and, while the recipient is signing for his message, to boost his invention. Mr. Felberbaum made the inauguration vest for former President William Howard Taft and the resignation vest for former Secretary of State William Jennings Bryan.

The inventor of this coat claims that it will save lives in case of emergency

Minds that Work While Bodies Sleep

Some authenticated cases of a much doubted phenomenon

By **Edwin F. Bowers, M.D.**



He might be called a "sleep-writer," since most of his writing is done while he is sound asleep

THE impossible is the thing we don't believe; the incredible the thing we have not yet seen. Both are states of mind common to the average human being. That is why any account dealing with manifestations of the subliminal mind—that mind which works while we sleep and at all other times, and which so few understand—must always be bolstered up with affidavits and attestations if it is to carry conviction. That is why the phenomena of unconscious cerebral and bodily activity have been considered, even by scientists, as old wives' tales.

And yet, among medical reports of abnormal mental conditions, and in the Proceedings of the Psychical Research Society, hundreds, if not thousands, of well authenticated cases of most extraordinary activities of sleeping persons have been recorded. In some instances the mental feats accomplished far transcended the normal capabilities of the individual.

Turning Sleep into Money

Such a case is the intuition—or perhaps it was the clear subconscious grasp of business detail—of a Russian banker who was addicted to the habit of getting up at night and looking over his papers while asleep. The banker had been examining the prospectus of an oil company about to be formed, in which he had planned to buy an interest. After mature deliberation with his objective mind (the mind we use while awake) he decided not to "take a chance."

However, a few days later his agents told him that, following his instructions, they had bought heavily for his account, at the same time showing him a letter in his handwriting authorizing this purchase—a letter he had written while somnambulistic, and of which he had not the slightest conscious recollection. Within two years the banker had added two and a half millions of dollars to his account—which puts him in the championship class of sleep-walking money-makers.

But, while one person does something constructive during a somnambulistic attack, a dozen do some destructive or absurdly foolish thing. Such, for instance, is the case of an English nobleman who, missing his shirts almost at the rate of one a night, accused his valet of stealing them. The very next night the erratic nobleman was seen stealing out in his pajamas, carrying a soft-bosom dress shirt under his arm.

Proceeding cautiously to the back of the barn, he secured a spade, dug a shallow grave, and buried his shirt. Investigation showed that all the remaining shirts had been interred in the same way.

She Hid Her Ring from Herself

Dr. John D. Quackenbos, of New York, tells me of an instance in which a patient, a young woman well known as a successful writer of short stories, was taking treatments by hypnotic suggestion which materially increased her powers of concentration and quickened her imaginative faculties. Through an oversight on the part of one of the nurses, she was permitted to leave for home while in a somnambulistic condition.

When she "came to" the next morning, she found that a valuable diamond ring was missing. Calling on the doctor, she made known her loss, adding that she had the impression that she had given the ring to a beggar.

Dr. Quackenbos immediately put her into the hypnotic condition, and gave her strong suggestions to the effect that when she returned to her home she would remember where she had hidden her ring.

Within an hour she called up, exclaiming: "Doctor, I've found my ring in the lining of an old muff—a muff I was going to give away today."

Sleep-walking made millions for a Russian whose wits were keenest when he was asleep

A Sleeping Novelist

Dr. Quackenbos himself is a rare and remarkable example of constructive somnambulistic activities, for some of his rather voluminous writing is done while he is objectively sound asleep.

It is his practice to arm himself with pad and pencil on retiring. On awaking in the morning he frequently finds that he has covered sheet after sheet of paper with a perfectly coherent essay. It was in this manner that Dr. Quackenbos wrote his fascinating study called "Body and Spirit."

In this connection it may be interesting to know that Dr. Quackenbos holds firmly that anyone who will take the trouble to cultivate the faculty can develop a psychic mental stream which will inevitably sweep ideas, impressions, and memorizations into objective consciousness, there to be utilized in solving business problems, and in assisting in the conception, construction,

Burying his shirts was the by-night occupation of an English sleep-walker

and completion of all work of a creative nature.

He advocates that one should comfortably compose himself and go to sleep for an hour or more with the problem, the story-germ, or what not, firmly fixed in mind. When the objective mind relinquishes the burden of thought—in other words, when the subject goes to sleep—the subconscious mind takes the matter up and carries it forward, together with the memory impressions of the subject.

The Sleep-Swimmer

A most interesting case, showing the unique coordination between muscle and mind in a somnambule, is recorded in which a young man, totally unable to swim in his normal waking condition, was accustomed to getting up at night two or three times a week and swimming across a river two miles wide.

Psychologists insist that, were this young man to be awakened while swimming, he would inevitably drown, for his objective mind could not transmit to his motor nervous system the impulses toward actions with which it was not itself acquainted.

This is supposedly the same form of mental and muscular correlation that enables the somnambule to walk fearlessly, and usually with safety, upon some precarious ledge or dizzying height.

While the erratic antics of the sleep-walker usually have a "happy ending," the uniformly accepted belief that no accident ever befalls him unless he be suddenly awakened is fallacious. Numerous deaths from accidents to sleep-walkers testify to this.

A most remarkable case of somnambulism, combined with "externalization of faculties" and other psychic powers, was reported by a famous New York alienist and neurologist only a few months ago.

The subject was a Bavarian peasant girl, simple, good-hearted, and very ignorant. The gentleman in whose home the girl worked as a domestic was a student of psychic phenomena and a hypnotist of considerable skill.

Drunkards and sleep-walkers are said to be providentially protected

He had, it seems, developed a wonderful telepathic rapport with this girl, and had brought her to his friend, the neurologist, for experimental work.

Thrown into the cataleptic state by hypnosis, the girl would inhale deep draughts from a bottle of the strongest ammonia, under the suggestion that it was perfume of roses. She chewed a strychnia tablet, perhaps the bitterest thing in the world, with gusto and relish, under the belief that it was sugar. Blank cartridges were fired off behind her head, without producing a single quaver of shock appreciation. Tested as to her accuracy in telepathy, it was found that she could read her employer's every thought.

Her Mind Saw Another Room

The alienist, to extend the scope of the experiment, directed that the girl—or her subliminal mind—proceed upstairs, enter a certain room (his daughter's bedroom), and describe what she saw there.

After an interval the girl announced that she was in a bedroom, and described in detail the physical characteristics of the doctor's daughter, a little girl of eight years.

Asked to count the number of chairs in the room, she announced that there were nine—two more than the number usually kept there.

Thus far the results might have been due merely to the ability of this girl to read the doctor's mind and to describe what he well knew. But, on being asked what was on the mantel, the girl replied, "A picture of a horse."

Now, the doctor was certain that there was no picture of a horse in his daughter's room. So, leaving the subject lying on the couch, the experimenters proceeded to the little girls' room.

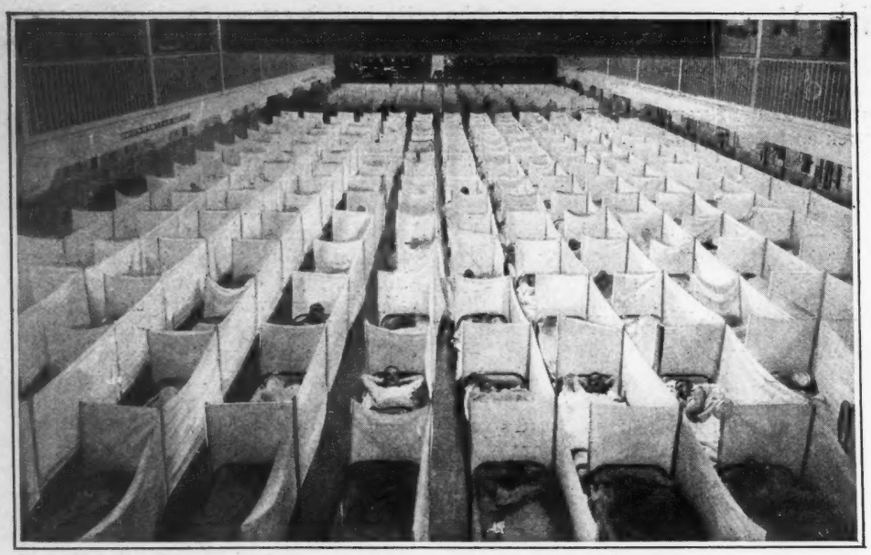
The mantel contained only the usual school-girl trifles.

"Just a clever mind-reader, after all," said the doctor. "She can't externalize her seeing faculties. She sees only what you and I have in our minds."

"Hold on," said the doctor's friend, stepping over to the mantel and picking up the photograph of a horse that was lying flat on the shelf. "What's this?"

It was a snap-shot of one of the doctor's horses, taken in the country by his little girl.

To explain these things is more difficult than to describe them. It is generally believed, however, that sleep-walking is only a form of auto-hypnosis. Somnambulism is generally confined to children, or to the youthful—in other words, to those happy people who still preserve illusions. Frequently, however, it accompanies a neurotic disposition; or it may result from great mental agitation. Lady Macbeth furnishes a classic example of this.



The screens hedge in sneezes so that they will not spread their germs to all the sailors in the barracks

We Now Have Sneeze-Screens

KER-CHOO! sneezed the sailor lustily; yet not one of his fellows complained, for he was surrounded by a screen erected for the purpose of foiling the plans of germs.

The screens are made of unbleached muslin. Each screen is tacked to three poles four feet long. In the day-time they are rolled up and stowed away, and at night they are brought out again. Each screen is spread across the head and one side of each bunk, the poles being fastened to the legs of the bunks. As the bunks are placed in regular rows, this arrangement protects the men on all four sides.

The popular disease of the day is supposed to lurk in coughs and sneezes, so that a sneeze is no longer considered an occasion for saying "God bless you," but as a signal to bring out masks and screens.

New Blades for Old Razors

SAFETY razors are made so that dull blades may be taken out and newer, sharper ones inserted. But in the old-fashioned kind the bare blade has to serve throughout the razor's lifetime.

Nathaniel Orr and George Snyder, both of Virginia, have patented a plain razor in which the blades work in shifts. The blade-holder is made U-shaped and has two rivets running through it. The blade is grooved so that it fits around these rivets, and has an extension, under which a latch swings, locking the blade in place.

In this new razor the saw-toothed latch swings up under the removable blade and holds it in place

Keeping the Railway Mail Clerk on His Toes

THOSE who imagine a railway mail clerk has nothing to do except to kick off the bags of mail at way stations and "use the hook" to pick up bags while going at fifty miles an hour may see the error of their ways from the accompanying photograph showing one of the tests that the railway mail clerks in Canada undergo—and their brethren in the United States pass through much the same ordeal.

The test must be taken each year, or there will be no salary increase forthcoming. The case examiner, as he is called, carries about with him a case containing 100 pigeonholes, all plainly labeled with the initials of a "run"; 1,000 cards 2 x 3 inches on which are printed just such names and addresses as might be found on letters picked up for distribution; and a set of scales adjusted to weigh to the hundredth part of an ounce.

The examiner, in the presence of the clerk taking the test, first weighs the cards. Then they are turned over to the "examinee" to sort into the proper pigeonholes just as if he were on the mail-car.

When he has finished, the examiner takes the cards from the pigeonholes one after another and quickly runs through them. If he finds a card sorted to the wrong railway post-office, he displays it to the candidate, who, if he thinks he is right and the examiner wrong, has the privilege of demonstrating it by reference to his distribution book. After all of the cards have been checked they are again weighed to see if the clerk, not knowing in which pigeonhole to place some card, has decided to hide his ignorance by holding it out.

This mail clerk will not get an increase in salary unless he can demonstrate that he is worth it

In Canada the railway mail clerks are required to sort the 1,000 cards in 90 minutes or less, and to have at least 900 of them correct, in order to be entitled to a salary increase.

The examination also includes a written test in which the candidate must tell in writing how, under various circumstances, he would most expeditiously get a letter or mail-bag to its destination, and show that he knows the ins and outs of the postal laws.

Calk the Seams with Wax

A CANDLE and an iron near each other usually means cleaning day for the iron. Not so with the candle and iron shown here. They are waterproofing a tent. Every time rain poured down on this tent, it trickled through the leaky edges and wet the things within. After a few wettings the camper bought a candle and borrowed an iron.

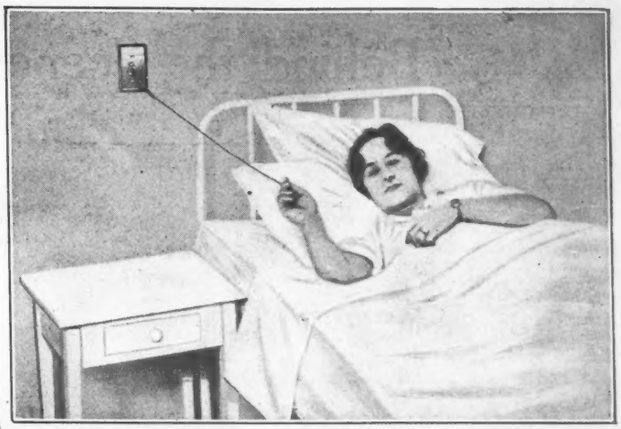
First he melted the wax and rubbed it into the inside and the outside of the cracks. Then he ironed it out with a hot iron.

His tent was thus made waterproof and will continue to be so, unless the sun should get hot enough to melt the wax.

The first candles were made of beeswax—a liquid secreted by glands in the abdomen of the bee. He uses it in making the honeycomb. To abstract the wax the honeycomb must be heated in water, when the wax rises to the surface.

When candles became popular, bees were not able to keep up with the demand; now vegetable and mineral waxes are used.

He's making his tent waterproof with the help of a melted candle and a hot iron



She pulls the cord, thereby closing a switch which is connected with a signal in the nurses' room

Summoning the Nurse

FIRST thought: how charming she looks; second thought: what is she pulling? A cord to summon the nurse. The cord is attached to a switch designed for hospital call service, and therein lies its superiority.

All the live parts terminate in the wall, so there is no chance of the patient adding electric shock to her other ailments. One pull on the cord closes the switch, and so rings a bell or lights a light or drops a signal in the nurses' room. It also causes a push button located above the cord to jut out. The signal remains "on" until the nurse comes.

Listen to the Professor of Butchering

"DID you study your chops last night?"

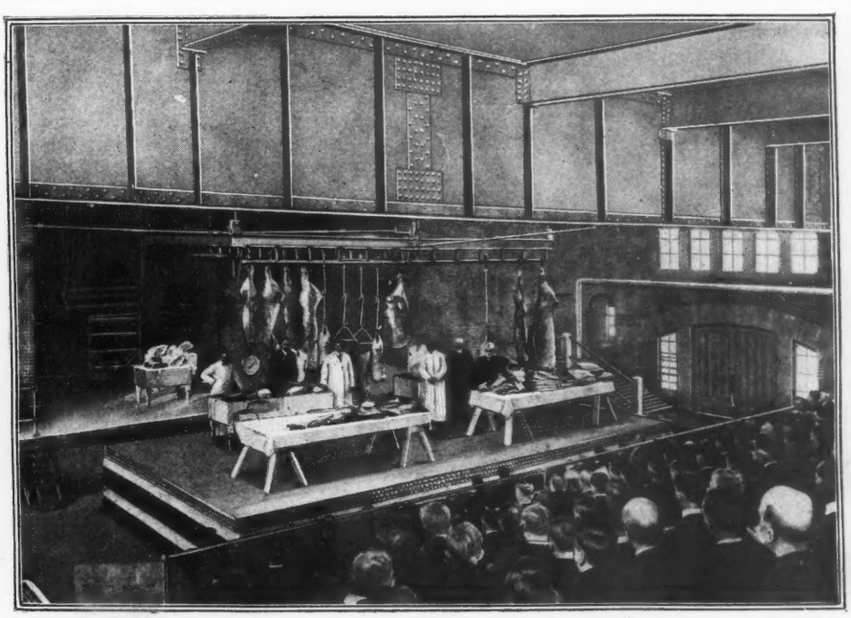
"No, steaks," they whisper to each other.

They are sitting in Slaughter-House Hall of the Iowa State College of Agriculture, where they are learning to be butchers. Iowa College has an Animal Husbandry Department in which men learn to be expert ranchmen and farmers. The slaughter-house is part of this department.

The student and the animal enter together, and stay together until the student has turned into an expert butcher and the animal has turned into steaks and chops. Guided by an instructor, the student kills it, cuts it up, and cures it if necessary.

We publish a picture of the cutting class. The students sit in the gallery, and the instructing butchers, with their blocks and carcasses, stand on the platform. They show the students where steaks end and chops begin, where legs and shoulders should be cut off, and all the other secrets of the trade.

Afterward the students come down to the platform and put their knowledge into practice.



Iowa State College of Agriculture has a course for ranchmen. In Slaughter-House Hall they learn to be butchers

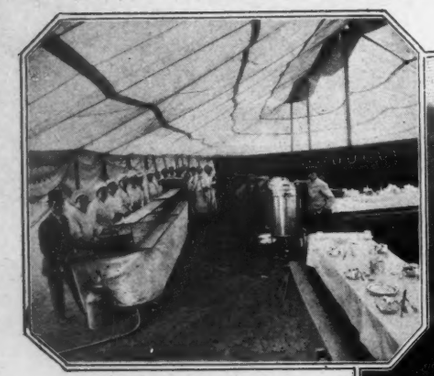
Flying Men Must Not Shoot Flying Birds

FOWL have the right of way in air, warns the director of military aeronautics. This is justice indeed, since birds flew first.

But this is not all. Recently many towns along the Atlantic coast have been visited with dead-bird showers. Aviators flying by a town would see a flock of wild fowl coming their way. They would set their machine-guns and let the bullets fly.

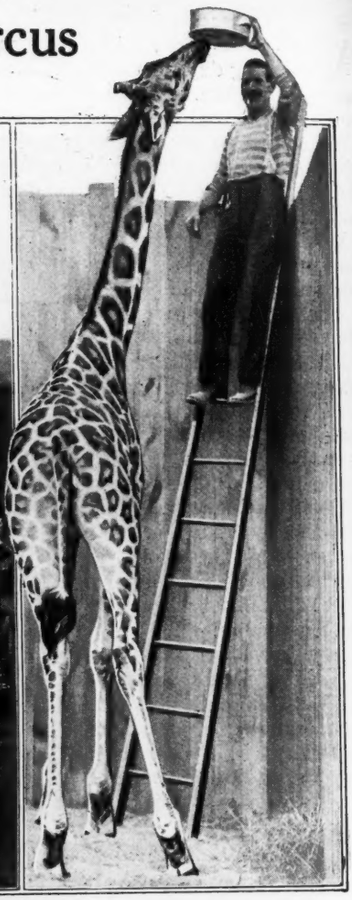
Presently a prominent citizen walking below would be hit with a large, bloody bird. He complained to the town, and the town complained to the Department of Agriculture. Then the Federal migratory bird law between the United States and Great Britain was referred to, and it was found that shooting birds from airplanes is unlawful.

Behind the Scenes at the Circus



Clowns, stake-drivers, acrobats, the living skeleton, and even the fat man, all must eat. And so when their daily work is done they pile into the lunch-room

The picture on the right shows cat-saddle practice. The two on the left made a cat saddle by crossing their hands and threw her in the air; the one on the right will catch her in his hands



You can't make a giraffe jump for his food unless you feed him from a second-story window; but at least you can make him stretch for it—so this animal man has found—if you stand on a ladder

A wagon's "make-up" doesn't wear off much, but it does get dirty; that's why there are always one or two wagons in their dressing-room, getting washed and touched up

If you tickle a wooden man on the cheek with a paint-brush, he will neither blink nor smile; he can't crack a smile in safety

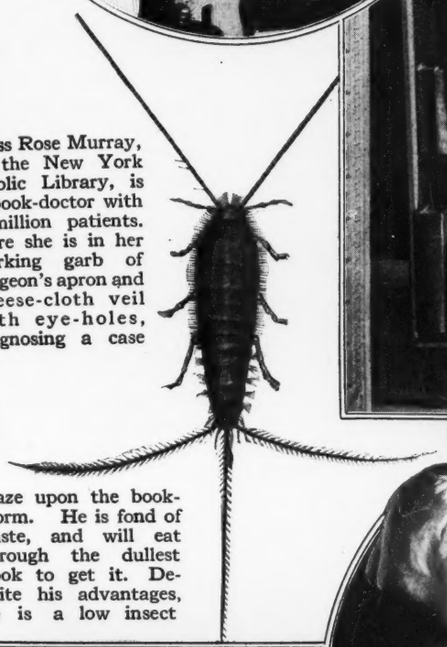
Things are not always what they seem—nor people; these are the dainty circus belles!

Taking in the seams, letting out the hems, putting on the spangles in the costume repair shop

On the Trail of the Bookworm

Miss Rose Murray, of the New York Public Library, is a book-doctor with a million patients. Here she is in her working garb of surgeon's apron and cheese-cloth veil with eye-holes, diagnosing a case

Dirty books, shabby books, books with broken bindings, all go to Miss Murray, who probably holds the record of having opened more books than any other person in the world



Gaze upon the bookworm. He is fond of paste, and will eat through the dullest book to get it. Despite his advantages, he is a low insect

Curing a book of a weak back by an application of paste while a novice looks on and learns how it's done

(*At left*) Shaking the dust out of a classic. Fresh air and clean surroundings are the cure for bookwormitis

(*At right*) Where a bookworm burrowed. More often, says Miss Murray, volumes suffer at the hands—dirty hands—of people

Carry Your Wireless Telephone with You

A STOVEPIPE, a little black box, and a combined transmitter and receiver are all you need for a wireless telephone of your own. The stovepipe is the aerial, and the little black box hides the mysterious secret of its success, which is known only to the inventor, W. W. MacFarlane of Philadelphia.

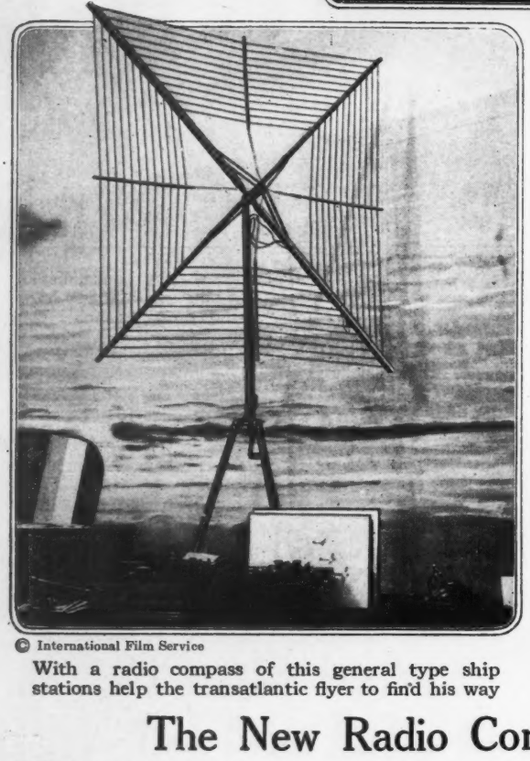
You hold up your stovepipe, adjust your wave length, say, "Hello," and he will pick up your wave and answer. That is what Mr. MacFarlane is doing here. He is using three stovepipes to be triply sure of success, for beside him is a skeptical reporter.

As this picture was taken he was talking to his wife, who was sitting in their garage half a mile away. Said he: "We are going to run down the road. Can you hear me?" Said she: "Yes, perfectly. Where are you?"

The picture below shows the inventor talking into his wireless telephone, with its three stovepipes. In the absence of a stovepipe, a rifle can replace the aerial

Both the reporter and the chauffeur wore receivers connected with the instrument. They heard her voice quite clearly.

The little black box—always black—weighs twelve pounds and is a foot square. Besides other things it contains substitutes for the audion bulbs, tuners, and amplifiers.



© International Film Service

With a radio compass of this general type ship stations help the transatlantic flyer to find his way

The New Radio Compass

THE old-fashioned wireless used to send and receive its messages from an umbrella-like aerial or from some allied type. The result was that the electromagnetic waves it sent out traveled broadcast, so that any operator who happened to be listening might hear; and, since there was no concentration of energy, the wireless waves were not very powerful in any one direction, nor well governed taking them as a whole. Unfortunately, this is still true of most sending stations.

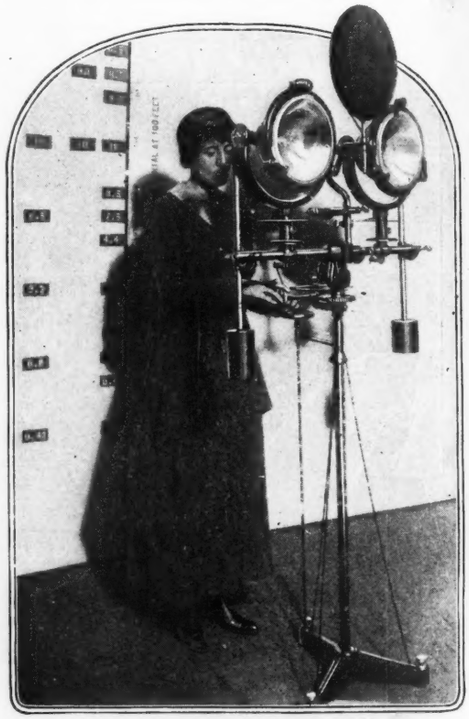
Receiving, however, has been materially bettered. Now a listener can tell the direction of a sender. The receiver's aerial is of the type shown above. It revolves about a central axis. When the top edge of the frame "points" toward the sender, signals come in the loudest. When 90° either way, signals are weakest. Going by the strength of signals, then, a receiver can soon get his aerial "pointing" toward the sender, or "crosswise," and figure therefrom the sender's direction.

Ship and shore stations followed the progress of the transatlantic flyers with direction finders of this general principle.

Measuring the Lights of Head-Lamps

SPECIALLY equipped laboratories have lately been established in which light measurements and tests and a great deal of experimental work in the field of artificial illumination are conducted by experts.

An important branch of this work is the measuring of light from automobile head-lights; for the laws in most States prescribe certain requirements concerning the illuminating power of head-lights. Our picture shows a woman expert in the New York laboratory about to test a pair of automobile head-lamps. Under the laws of that State the head-lights of an automobile must give enough light to make objects clearly visible at a distance of two hundred feet, without throwing a glare in the eyes of drivers of approaching cars. The tests made in the laboratory are official and its findings are accepted in approving or rejecting lamps for general use.



With the aid of this apparatus, women experts test head-lights for automobiles

Spy-Glasses on Guns

Bringing the game nearer with grandfather's old telescope

By Captain Edward C. Crossman, U. S. A.

DARKNESS was creeping into the grove. Forty feet overhead, in a crotch of a huge limb, something seemed to be snuggled that did not fit in with the usual outline of a black-walnut limb. Vainly the hunter tried to see it. Hastily he drew from a leather case by his side a thin steel tube, possibly a foot long and not much thicker than a man's thumb. He slipped it on the rifle and tightened a thumb-screw. Again he pitched the rifle to his shoulder.

Through the tube the great limb ceased to be merely a blur. In relief against the dark bark were two ghostly crossed hairs, their intersection at the exact center of the circle of light that came from the lenses. The tube crept along the limb to the crotch.

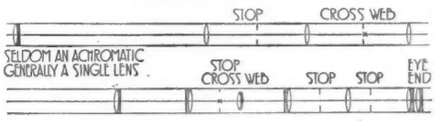
The something that the hunter suspected did not belong to the tree was suddenly revealed—a sharp ear, a bright eye, an impudent nose with the sensitive nostrils above, set in a background of light gray fur. The intersection of the hairs rested for an instant on the bright eye. Bright flame spurted from the black muzzle of the rifle. Something fell into the leaves at the foot of the tree.

If you took grandfather's old ship's telescope, focused it, and fastened it on a rifle, you would have the primary principle of the rifle telescopic sight. You could not hit anything with the rifle so fitted, because there would be nothing in the telescope to direct the aim.

If you carefully fitted a pair of crossed fine silk hairs or the finest possible steel wires in the focus of the lens at the eye end of the glass, so that the magnifying eye-lens enlarged the hairs as well as the image formed by the object lens at the front end of the telescope, you would have the second step of the telescopic rifle sight.

If you altered the fastenings of the instrument so the junction of the fine hairs and the point of the strike of the bullet agreed at some one desired distance away from the rifle, you would have the third step.

When the point where the hairs cross bears directly on the woodchuck's head, it is the moment to pull the trigger



The upper half of this diagram shows the old type of telescope sight; the lower half, a later type with achromatic lens. "Stop" means diaphragm. Like ordinary telescopes, the telescope rifle sight has a lens (the object glass) at the forward end which forms the image. At the eye end is another lens (the eye-glass) which is a simple form of microscope, and which takes the image from the object glass and magnifies it

The power of the telescope rifle sight is low. This at first seems strange, because the more we enlarge an image the closer it seems and the plainer we can see the object. Nine times out of ten the ordinary American telescope sight is less than five power. Here's the reason. The rifle, in human hands, moves constantly. The vise like grip died with the heroes of Fenimore Cooper.

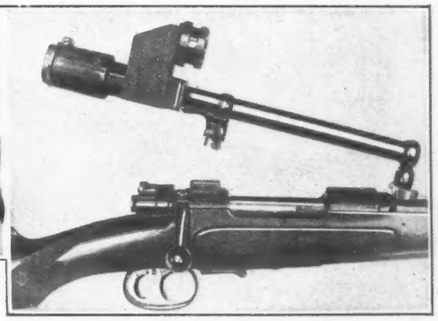
Point the telescope sight at a distant brick chimney. If without the telescope, we find that our front metal sight moves just the width of a brick in spite of all our efforts to hold steadily. With the telescope it still continues to move the width of the brick. As the image is enlarged five times, the rifle apparently has to move five times as fast and five times as much to continue to swing from side to side of the brick. The result is that the shooter beholds the cross-hairs galloping back and forth across a greatly magnified picture of a brick. With the ten-power glass the effect is just that much worse.

Two other reasons, minor but valid, are that the greater the magnification the less the light passed by the lenses—and we must have plenty of light.

The common form of American telescope sight is a steel tube from three fourths to a full inch in diameter and from ten to fifteen inches long. In the best make the lenses are known as "achromatic"—which means corrected for color dispersion. The old form of cross-hair is giving way to other and more useful forms. Probably the best form for hunting is a little slip of steel running to a sharp point just at the center of the tube. Sometimes, to strengthen this, another wire is run across the tube from side to side, intersecting the picket just below the point. Should this be our form, then whenever we touch our mark with the sharp point, our rifle is sighted for it, and the bullet will strike there.

The telescope sight as mounted on a sporting rifle. Prismatic glasses will add half an hour to the evening shooting

The American type. It is good for target work, but not for war. Its low power makes it excellent for twilight shooting. The power must be low because, in human hands, the rifle is constantly on the move



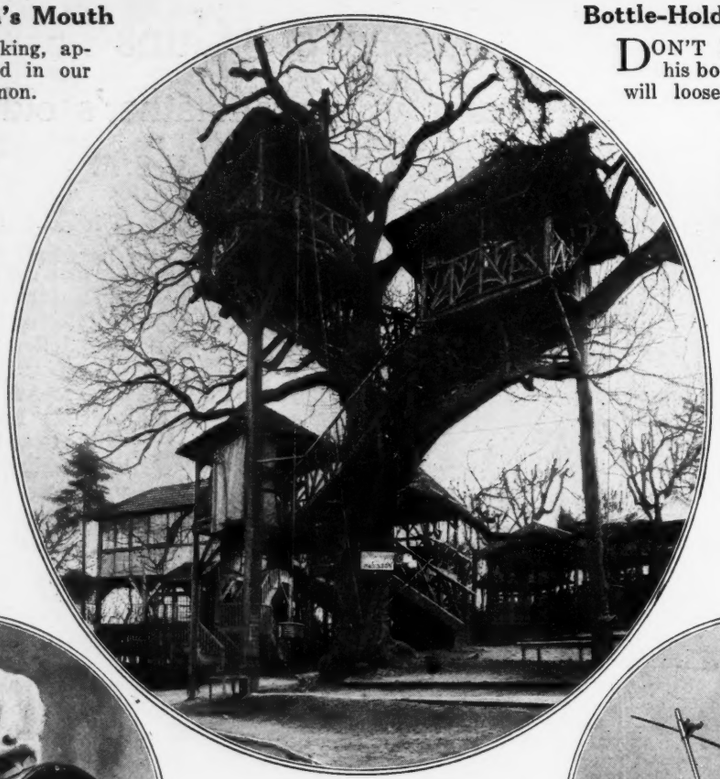
German telescope sight, showing how to detach from rifle. War also has proved the value of the telescope sight

A Rat at the Cannon's Mouth

IF a cat may look at a king, apparently a rat may—and in our picture does—look at a cannon.

This particular rat is stepping down gently from one of the recoil cylinders to have a peep at the barrel of a powerful mortar which once did its part to make the world unsafe for the Allies. When this picture was taken it was on its way to help boost the Victory Loan in a Western city.

When the rat looks into the barrel he will probably not notice that it is rifled—which is rather unusual for mortars. The mortar is one of a collection of captured German guns brought over on a transport as visible evidence.



Bottle-Holders for Bottle Babies

DON'T hold a baby responsible for his bottle. If he is very young he will loose his grip on it and go without a meal. If he is old enough he will throw it away and smash it when he's had enough. A bottle-holder like the one shown below will keep the bottle aimed directly at the baby's lips until you come and get it. He cannot choose but eat.

This bottle-holder is made of three metal arms jointed together and having a screw at each joint to keep the arms fast or loose. In this way the bottle may be properly aimed. The bottle itself fits snugly in a wire case attached to a spring, which is attached to the holder's third arm.

© Underwood & Underwood

How We Make Marksmen

ONE of the reasons why our marines shot so well at Chateau Thierry and Belleau Wood is shown below. It is a section of the naval rifle-range at Great Piece Meadows, N. J., displaying a rear view of a few of the hundred targets, with the mechanism for raising and lowering them in plain view.

In one regiment of marines about 93 per cent of the men wore shooting medals.

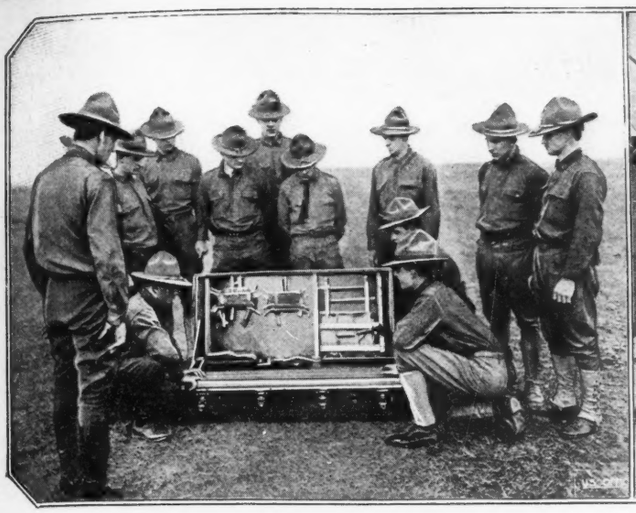
Tree-Top Tea-Rooms

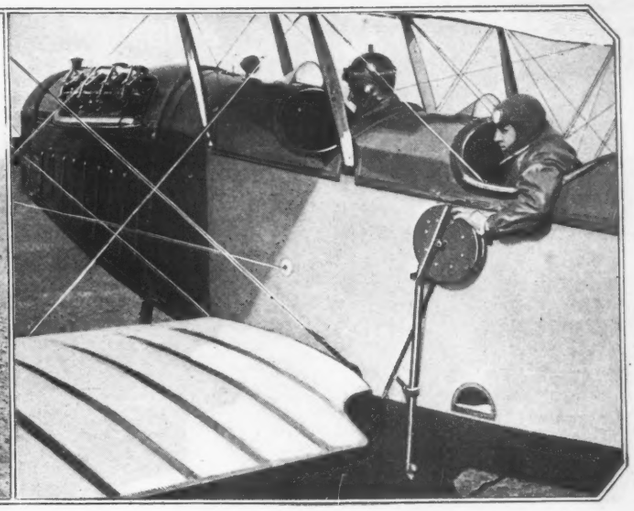
WHEN the bough breaks the tea-room will fall, and down will come teatotalers, tea-room, and all. But that thought does not worry the folks who are merrily drinking tea in the tree-tops.

This is the village of Robinson, situated just outside Paris. It was built in memory of Robinson Crusoe, and symbolizes the kind of time he ought to have had when he came back from his island. Besides these tea-rooms, there are dance-halls, "movies," merry-go-rounds, and many side attractions.

Orders taken in the tea-room are sent below in baskets. The baskets are then filled and hoisted up.

© Western Newspaper Union





This "Central" Lives in a Trunk

A RADIO-TELEPHONE outfit that travels in a trunk makes it possible to set up a sending station anywhere and chat with a passing airplane thousands of feet overhead, providing, of course, the airplane has a wireless telephone on board.

The radio-telephone came just too late to be tried out in battle. It is an adaptation of the principle of the wire telephone to wireless conditions. As in the familiar telephone, there is a diaphragm and a capsule of carbon granules; but, instead of varying the intensity of a current passing over a wire, the radio transmitter varies the strength of a stream of electro-magnetic waves.

The Ears of the Airplane

WHEN the radio-telephone, adapted for airplane uses, was added to the other war-born marvels, the question of how to rig the aerials was a bothersome one. At first a long, single cable was tried out. It was kept from flying up and entangling itself in the machine by a heavy weight, and swung 300 feet or so below the airplane.

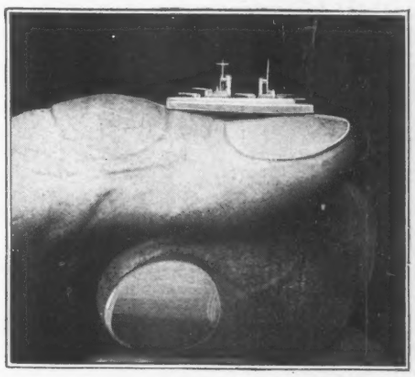
These long dangling cables were a menace to machines flying in formation. They were raised and lowered by a reel attached to the side of the airplane within easy reach of the pilot's hand. The more recent practice is to suspend short, weighted wires from the wing-tips or, in some cases, to arrange the aerials between the wings.

Flapping Her Under-Water Wings

ONE rudder is not enough for a submarine; it must have horizontal as well as lateral steering machinery to assist in keeping on an even keel when running submerged. In the early under-water boats the horizontal bow rudders—hydroplanes as they are called—showed above the water when the boat was running on the surface instead of below.

But it was found that the waves pounded the rudders unmercifully, and so in later types they are arranged to be always submerged. The hydroplanes fold back into the superstructure of the submarine. Properly set, they'd be seen edgeways.

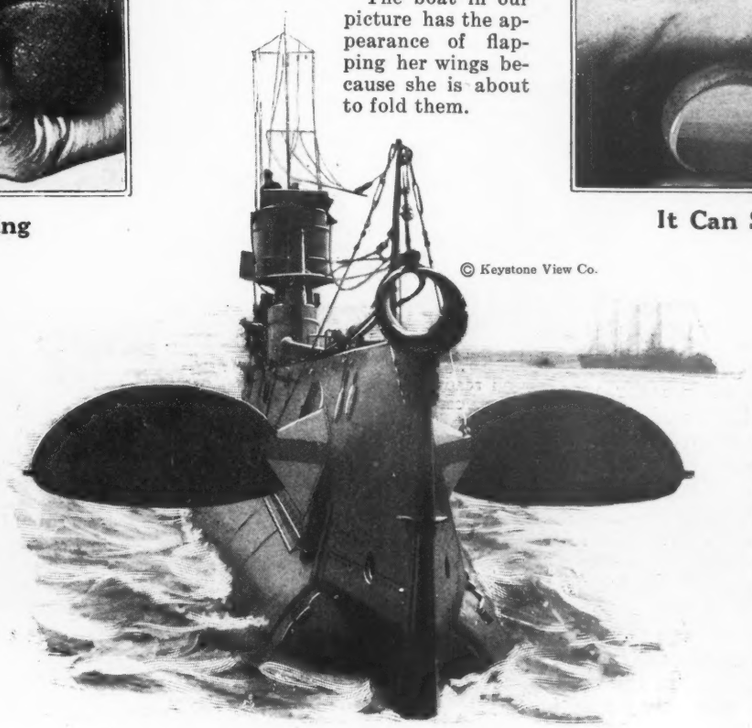
The boat in our picture has the appearance of flapping her wings because she is about to fold them.



Let's Go Truffle-Hunting

DID you ever hunt truffles? Not unless you lived in France and had a truffle hound —which isn't a dog at all, but a pig with a nose for truffles. In two country places about thirty miles from Paris the owners have pigs trained for the truffle hunt.

The moment a pig roots out a truffle, his master distracts his attention and abstracts the truffle. Of course the war boosted the price of truffles along with everything else, and the roots became as scarce as they were desirable.



© Keystone View Co.

It Can Sail on a Raindrop

A BATTLESHIP on his thumb! Surely he must be Gulliver and the battleship must belong to the small people of his travels. No; the thumb is anyone's thumb, and looks just as yours would look if we took a picture of it. The battleship is a ¾-inch reproduction of the German dreadnought *Koenig*.

In making this small model each part had to be reduced about ten thousand times to keep it in proportion to the 600-foot original.

Hopeless, eh? No, reader! Only a test stop which the manufacturers made, starting again without assistance

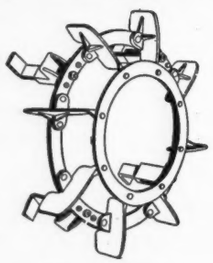
As easily operated by a woman as by a man, this rim assures the woman driver of her mechanical efficiency

Mud No Obstacle to This Device

"BUT, man, it's impossible with those roads a foot deep with mud." My friend stepped into his garage, returning with two objects that looked like miniature tractor wheels, which he fastened to the hind wheels of his heavy car.

A few minutes later we were literally "paddling" through a lake of gumbo, emerging with the radiator as cool as when we started.

It is a ring fastened to the outside of each of the driving wheels that does the trick. To these rings are attached eight blades set at an angle of fifteen degrees, so that they may exert the proper pressure. The blades are fastened to an outside guard ring, the complete device being attached by bolts to the inner ring.



When your car won't, this device will pull you out of the deepest mud

Off and On in a Jiffy

MANY people will appreciate the advantages of this ingenious tire rim. In case of a blow-out in a rain-storm, you quickly unbolt the rim, take it inside the car, repair it, and then slip it back upon the wheel, spending only five minutes in the rain.

No tools are required in operating this rim. It is broken by simply bouncing upon the floor or pavement, and brought back into position by a pressure of the foot.

The rim is applied to the wheel in the ordinary manner, but is hinged to facilitate removing the tire. It is so constructed that it is interchangeable with almost any kind of rim without alteration of the felloe or rim-band.

Does It Pay to Jack Up Your Car?

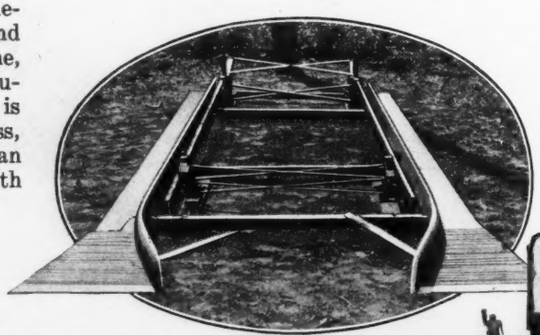
WHEN your tires, guaranteed for a certain mileage, start rim-cutting and blowing out before their time, you think hardly of the manufacturer who tells you that it is due to your own carelessness, but that he will make an adjustment—at his price—with which you have to be satisfied.

Did you know that more than one half of the tires that rim-cut and blow out do so because of improper care, such as standing with the dead weight of the car in one position for days at a time, and sometimes months, thus breaking down the tire walls by absorbing oil, grease, and moisture from the floors?

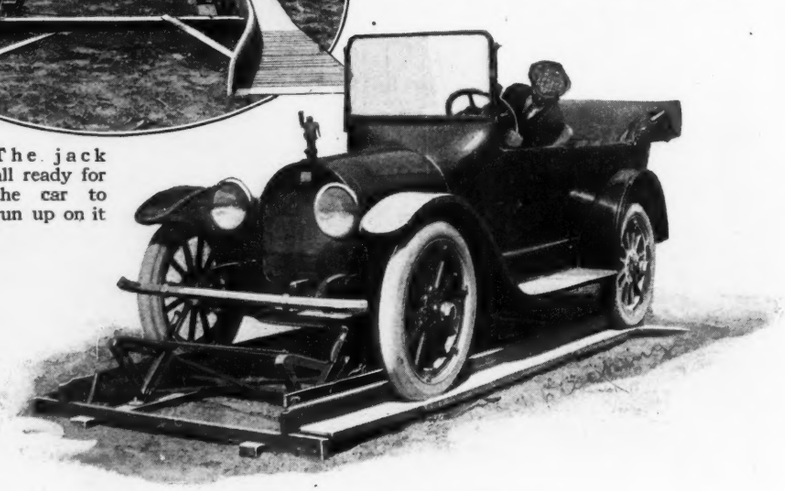
Does it pay to jack up your car? "Yes," you say; "but it's tedious, dirty work, and I haven't the time to spare."

You mean it used to be a hard task. It isn't any more, for with a new automatic automobile jack in your garage your car is driven in in the usual way, the car following the guide, and when it reaches the proper place all four wheels are instantly jacked up without any assistance from the driver. This is accomplished without lifting the weight of the car; neither is any particular speed necessary. The car is left supported on rubber-cushioned jacks, with all wheels free to be turned or removed.

To remove the car from the jack it is necessary only to press a foot-lever, when the car recedes under its own power.



The jack all ready for the car to run up on it

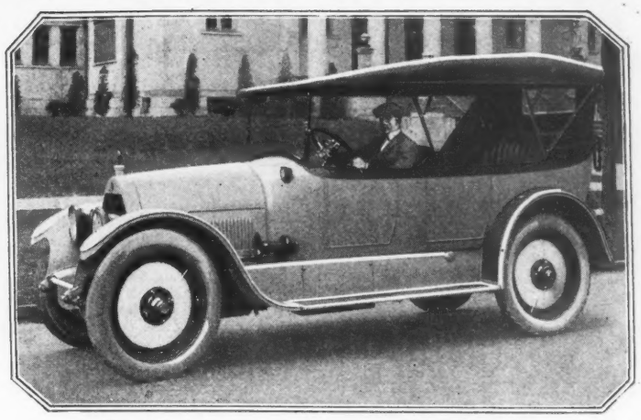


The jack at the moment of lifting the car. Think how this device will save tire bills

Are Wood Wheels Obsolete? It Seems Probable

SINCE time immemorial the wheels of vehicles have been of wood. No doubt the first wheels were sections cut from the trunks of trees, these being handy and obviously round.

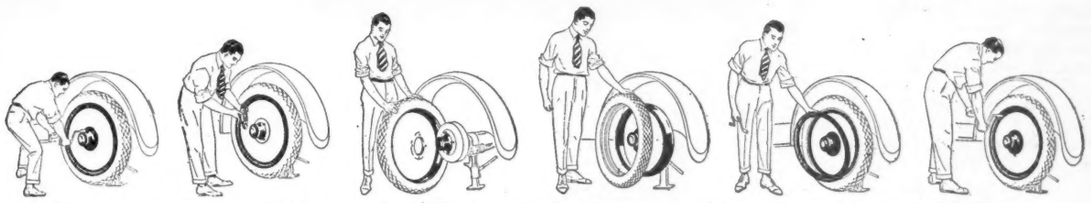
After a time, however, our forefathers discovered that solid wheels had their drawbacks. They were very heavy; they would split; they would swell when wet. Then some genius invented the spoked wheel. This was found to be very much better than the old solids.



Note the clean-cut appearance that the disk wheel gives to a car. Many advantages are claimed for it

Later came the automobile, and with it side-slips, collisions, and general hard usage. The old wooden wheel could not stand the strain. Then the users and manufacturers began to sit up and take notice. The wire-spoked wheel was introduced, and answered many needs.

Now comes the solid steel disk wheel. Much is claimed for it. Ease in cleaning, ease in tire changing, great strength, lightness, and economy are among them.



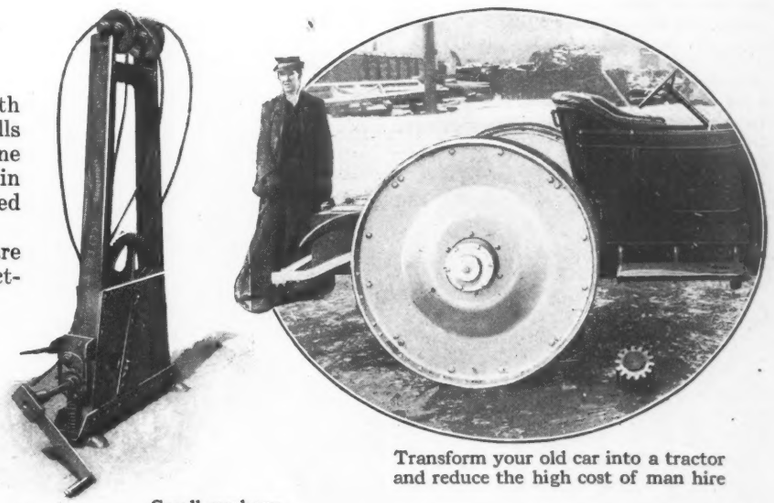
To remove and change this kind of wheel: Unscrew the four-flange nuts with a wrench; remove the hub flange and side ring, then the wheel; replace with the spare wheel. The whole job takes less than five minutes

You Can Lift Five Tons with This Hoist

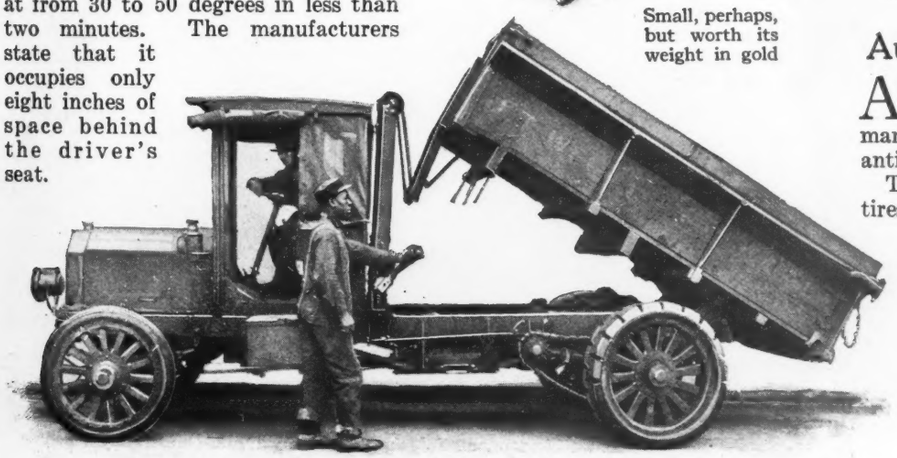
"ALL right, back her up—little more." With a rattling slide and a mighty roar, out falls the load of coal or stone. You've seen it done many a time where building operations are in progress, and have perhaps been rather interested to see such a big load so easily dumped.

The chief requisites of a dump-cart hoist are strength, speed, power, lightness, and compactness. All these are embodied in the machine here shown. It is very rigidly constructed of steel beams, yet it is not clumsy or unduly large.

The power is produced by a train of spurs and bevel gears, and one man can easily lift five tons by means of it. The whole body can be inclined at from 30 to 50 degrees in less than two minutes. The manufacturers state that it occupies only eight inches of space behind the driver's seat.



Small, perhaps, but worth its weight in gold



Rivaling Samson's feat of old, this gearing makes every man a giant in strength

Transform your old car into a tractor and reduce the high cost of man hire

Automobile Turns Tractor

A TRACTOR conversion unit for large automobiles is in big demand by farmers who own cars of antiquated models.

The original front wheels, with the tires, are still used. Two steel disk wheels 48 in. in diameter are provided with internal gear rings. A 14-tooth spur pinion is secured to each end of the axle-shaft, after the rear wheels have been removed. Vibration is taken up on a wood liner.

Of course, provision is made for cooling, and numerous devices are kept in stock for each machine to be converted.

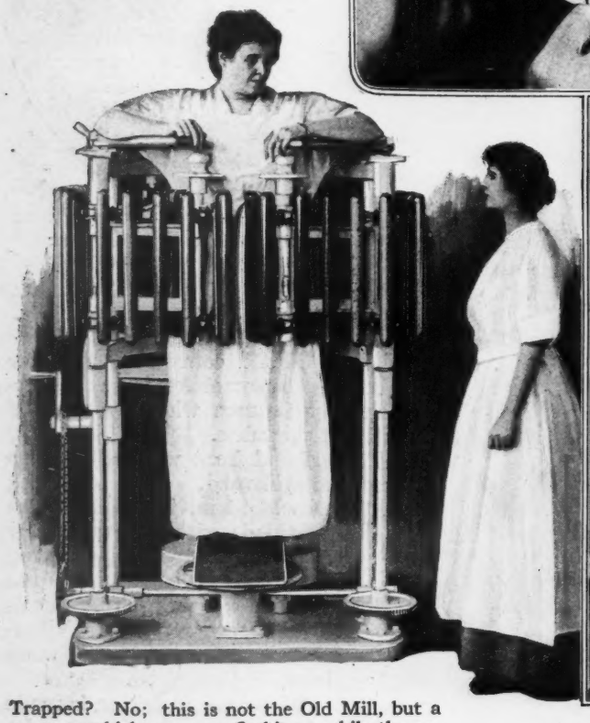
This Face Under New Management

Giving you a peep at

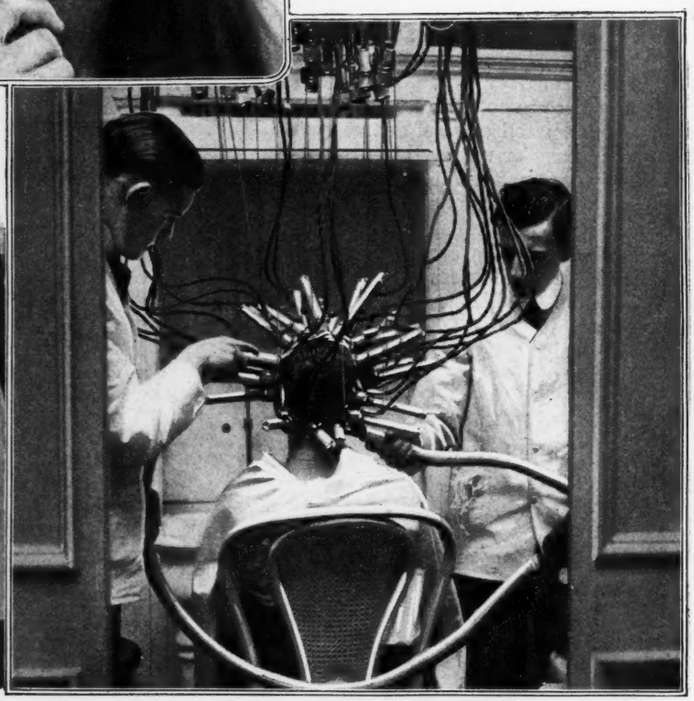
The young lady is not acting careless with a rubber stamp or purposely addressing herself for shipment through the parcels post. She is ironing out wrinkles after washing her face Monday morning. The advantage of the treatment is that it is unnecessary to use a wringer or hang the face out to dry. The harness about the head pulls on two pieces of plaster and keeps the skin tight for easy manipulation

This woman is calmly watching a posse of nurses pursue her rheumatism. It has been chased helter-skelter up her left arm, leaped across her shoulder-blades, coasted down her right arm, and will presently depart, due east, from her right thumb. Watch for it and avoid it. The machine administers heat with force and is exceedingly popular with the "ouch" element

Well may this young woman smile. She has read the circular that accompanies the massage roller now engaged in removing her slight double chin, and she is therefore convinced that she will never have a wrinkle; never be obese; never have dandruff; never lack circulation; never have a thin neck; and never, never cease to be beautiful. She could be forgiven for laughing outright, or chuckling, or anything



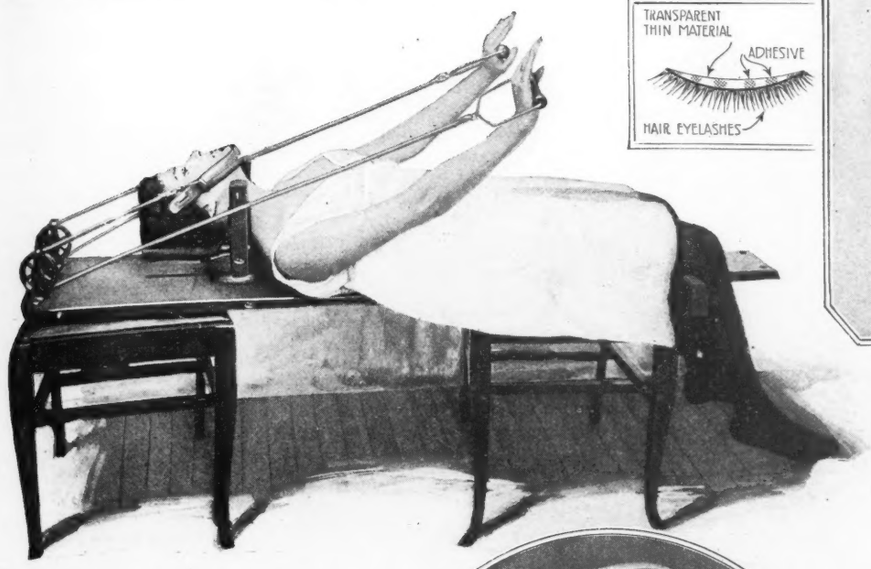
Trapped? No; this is not the Old Mill, but a new one which removes fleshiness while the patient waits anxiously. It can be adjusted to remove weight from the ankles to the ears, and its purpose is to present exercise to those who are too tired to take it. With this device in the market no shape may be regarded as necessarily permanent



This woman stopped in of her own free will and deliberately asked to have this done. When the White Wings comb the machinery out of her hair she will have a permanent wave, and even the most caustic cynics will admit that she deserves it. If it wasn't that a friend of hers lived through this she'd never expect to herself

—We Would Rather Stay Homely

the mechanics of beauty



This young woman is becoming beautiful, healthy, well built, and somewhat muscular by exercising at this angle and thus using muscles not usually called into play in the ordinary walks, jumps, and staggers of life. She is engaged in automatically preventing apoplexy, acid stomach, eye troubles, nose and throat ailments, and curvature of the spine. Small wonder that she busted the back off two chairs in order to follow the circular's valuable advice

The outstanding feature of this young woman's peculiar type of beauty is that she has what might be termed fairly snappy eyelashes. She felt that she needed them, and therefore bought them. They are fastened on with an adhesive substance, and according to the manufacturer's gossip can be removed only by blasting with dynamite

With this simple nocturnal bonnet persons who have for years slept with their mouths open can at last bring the subject to a close. With it one may foil the ills of adenoids, tonsils, and assure the good blood resulting from proper breathing. Its sole mission is to keep the mouth shut, and there are thousands of instances in which it might well be used from sun-up to sun-down. All in favor say "aye"

When this woman came in here after a splendid night's rest and a good breakfast, she looked somewhat drab. Now, after a tedious hour or more of steaming, rubbing, and semi-electrocution, her color is radiant and her expression both appreciative and alluring. Ain't machinery wonderful? Can it do something for our chin?

Nowadays they improve faces as thoughtlessly as they do real estate; but even now, for all we know, the patient may not be satisfied. Some folks are horribly particular

What Is Ahead of Us?

By Harrington Emerson

The world has received the greatest material setback in its history. More people have perished, more property has been destroyed, than in any other period ten times as long

DOES peace offer opportunity? Will America do her best?

When do trees grow most luxuriantly, bud and shoot, leaf and bloom? It is in the spring, after the killing and destroying frosts of winter.

When are wild animals thinnest? When do bears emerge, lean and gaunt, from their lairs? In the spring, after the exhausting and life-destroying winter.

During the strain of winter both plants and animals have used up their surplus, and in the spring they must joyously and energetically hustle.

When is man most hungry and when does he lay on flesh most rapidly? When he is recovering from an attack of wasting fever.

Are these lessons to go unheeded?

The Worst Setback in History

The world has just received the greatest material setback in all the experience of history. More people have perished, more property has been destroyed, than in any other period ten times as long.

Because there will be fewer people, the world will be relatively bigger than before. The sun's warmth, the rain, the soil's fertility, have not lessened. If human beings were trees or animals, they would recover with great rapidity; but we are human beings, and we may fail to realize that a new era has been born—born in travail, in agony, in blood, but nevertheless a great new era—and that it will take fifty years under wise leadership with best counsel and of greatest energy to catch up and to consolidate.

HARRINGTON EMERSON *is an efficiency engineer who has done things. He put into operation some of the first long-distance mail routes in Alaska; reported on the coal deposits on the western American coast; and advised in regard to the northern submarine route to Asia. After he became a consulting expert in management he gained wide recognition on account of the success of his methods on the Santa Fé Railroad. He has advised many syndicates concerning industrial plants and mines in Mexico, the United States, and South America, and today is one of the best known men in his profession.*

Is there ground for sober optimism? Yes, if we hold on to our fine qualities, if we have broad and clear thinking leadership, if we have experienced staffs, if we have intelligent, careful, energetic workers in the line.

The finest words ever spoken as to organization were those so briefly and beautifully used by Marshal Foch when he was thanking General Pershing. They contain all the truths that we must apply if we are to succeed in peace as we have succeeded in war. I shall paraphrase for the future what he said of the past:

"Complete success will come only if all display fine qualities. We must have breadth and clearness of conception in the leaders, we must have abilities and methods in the staffs, and we must have ceaseless energy and indomitable courage in the men in the line."

The outlook is very favorable, the opportunity is there.

America's Wealth

(1) It will take the world three to five years to build up the normal food supply. Because the United States is the greatest immediate purveyor of food (Russia being for the present too disorganized to count), the farmers will receive very high prices not only for grains, hogs, and cattle, but also for cotton. The farmers will want workers, and can pay the wages; and having sold for much they will buy much. Last year the farm products of the United States aggregated in value nearly $20,000,000,000.

(2) But the farmers are only a group in the great class that creates supplies by annexing what nature has provided and what man desires. There are our mines, our forests, our fisheries, our waterfalls. Silver, copper, zinc, lead, iron, gas and oil and coal, cement, lumber, electrical horsepower, all are going to be in great demand. Gold alone has lost value.

(3) Our products are going to be in demand because billions of property in Europe has been destroyed and must be replaced. They are going to be in demand because we ourselves at home have been falling behind. Owing to the war, we have curtailed our own improvements; they must now be brought up.

(4) We are literally bursting with surplus values in the United States, and all the world needs these values.

(5) One quarter of the world's shipping has been destroyed. To

recreate it will require materials, equipment, and workers.

(6) Vast areas have been swept bare of all the accumulations of centuries of saving. All this must be productively replaced.

(7) The existing industrial wastes in the United States amount to $50,000,000 a day. In a year this amounts to more than our total national debt. If we could save these wastes we could pay off the whole material cost of the war in two years. Happy is the nation whose income is so greatly above its needs that it can be curtailed $50,000,000 a day without reaching bed-rock.

These, therefore, are the five stimulating conditions: food shortage, ship shortage, devastated areas, the great current wastes, the need for improvement and betterments.

America's physical conditions are ideal. If there is any misgiving it is due to what lies within us, not without.

We are wasteful. In the last four years we have indulged in an orgy of waste. It will be difficult to stop it. We are provincial. We shall perhaps not know how to finance our sales.

Wise Men Take Chances

One American had the big idea. France wanted to buy of him, but had no money. His friends tried to dissuade him from taking French bonds. They feared that Germany would win; they feared that, even if France won, she could not pay.

"French bonds are good enough for me," he said, "and if France loses I would lose both bonds and freedom. But if France wins yet cannot pay, I shall only be back to shirt-sleeves, where I started."

If we are wise we shall take a chance. Take French and other bonds of every kind guaranteed or at least certified to by the respective governments, endorsed or at least still further certified to by our Government—bonds accepted by banks and made legal investments for savings funds, for insurance reserves, and for fiduciary investments. It is better to have some loss than to have the whole world stagnate.

Do I counsel recklessness? No. We have unfortunately been both conceited and reckless. Any tyro ought to know that "cost plus profit" is no proper basis for manufacturing. Our Government was warned but would not listen, and its inexperienced representatives wasted $3,000,000,000 on the cost plus profit iniquity. I counsel extreme hopefulness coupled with extreme caution.

Wastefulness, provincialism, overconfidence, are the faults of youth. They are serious faults, but they are not utterly destructive, as were the German and the Russian faults.

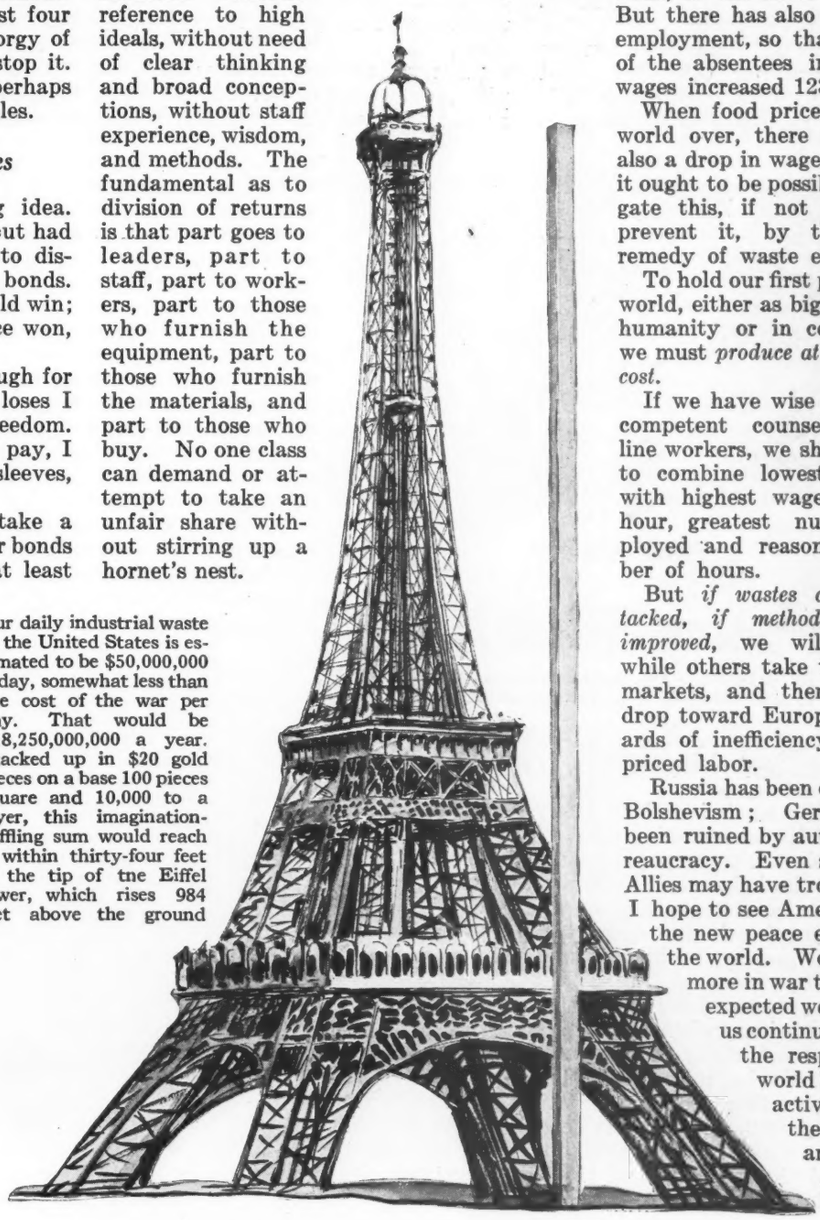
Autocracy is leadership without staff or line; bureaucracy is ability and methods without either leadership or line; Bolshevism is line without either leadership or ability.

What we must have is the balanced combination of all.

We have our minor problems.

Our Government in President and Congress came nobly to the front. An immense army was raised and sent overseas, billions were secured and spent, the end in view was achieved. Nevertheless, there was inefficiency as monumental as the enthusiasm.

Labor is uneasy. Some think that it can find a class solution without reference to high ideals, without need of clear thinking and broad conceptions, without staff experience, wisdom, and methods. The fundamental as to division of returns is that part goes to leaders, part to staff, part to workers, part to those who furnish the equipment, part to those who furnish the materials, and part to those who buy. No one class can demand or attempt to take an unfair share without stirring up a hornet's nest.



Our daily industrial waste in the United States is estimated to be $50,000,000 a day, somewhat less than the cost of the war per day. That would be $18,250,000,000 a year. Stacked up in $20 gold pieces on a base 100 pieces square and 10,000 to a layer, this imagination-baffling sum would reach to within thirty-four feet of the tip of tne Eiffel tower, which rises 984 feet above the ground

In return for wages, for materials, for equipment service, whether high or low, there should be a standard equivalent in output for the time used for the unit of material, for the equipment service, and each should receive the fair reward for his own contribution.

Wages Follow Price of Food

Wages have risen on account of the rise in the cost of food. Wages have always somewhat closely followed the price of food. In the State of New York from October, 1914, to October, 1918, wages on the average increased 81 per cent, but during the same period the cost of food increased only 73 per cent. Clothing increased about 50 per cent, miscellaneous articles increased 40 per cent, rent increased from 15 to 20 per cent, and the cost of service, from utility corporations, is the same as before. But there has also been more employment, so that, in spite of the absentees in the war, wages increased 123 per cent.

When food prices drop the world over, there may come also a drop in wages, although it ought to be possible to mitigate this, if not wholly to prevent it, by the double remedy of waste elimination.

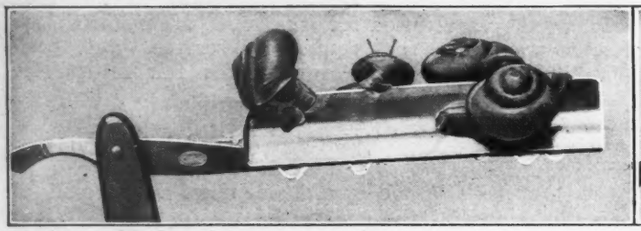
To hold our first place in the world, either as big brother to humanity or in competition, we must *produce at lowest unit cost.*

If we have wise leadership, competent counsel, rational line workers, we shall be able to combine lowest unit cost with highest wage rates per hour, greatest number employed and reasonable number of hours.

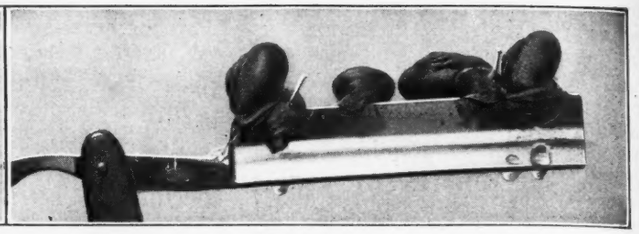
But *if wastes are not attacked, if methods are not improved,* we will stagnate while others take the world's markets, and then we must drop toward European standards of inefficiency and low-priced labor.

Russia has been engulfed by Bolshevism; Germany has been ruined by autocratic bureaucracy. Even some of our Allies may have trouble. But I hope to see America lead in the new peace evolution of the world. We have done more in war than anyone expected we could. Let us continue to deserve the respect of the world by our peace activities. All the conditions are favorable. It is our opportunity!

"Sharp as a Razor" Means Nothing to a Snail



One snail has crossed the sharp edge in safety, but the others are making a "snail's progress"



Just after the start. Two of the snails are still on the ruler, while two others are reaching over the razor-blade

A SNAIL may not be a very rapid animal, but he can walk along the business edge of a razor-blade without cutting his feet. But if you want to see the trick done you must load up a supply of patience. Here's what Dr. Edward F. Bigelow, who, at the suggestion of the editor, took the pictures for the POPULAR SCIENCE MONTHLY says about it:

"The snails will not crawl when one handles them, nor will they crawl much in sunlight; and, of course, it is difficult to take a photograph of a moving snail in the shade. The snails cannot be placed on a razor edge, for the moment they are touched they pull into their shell or if they do not the razor cuts them. To do the trick safely, they must go on voluntarily.

"So I placed a ruler about a quarter of an inch from the edge of the razor, put the snails on the ruler, and found that they would crawl off over to the razor.

"The snail seems to have no difficulty whatever in crawling even lengthwise on the razor edge if undisturbed. If touched in the slightest he quits and tumbles off. However, it is very interesting to see the snails crawl over the top and alongside the razor, provided one is willing to wait and wait and wait for his snailship to do the traveling. The snail, you know, travels only occasionally."

Other observers who have watched the snail do this trick say that he accomplishes it safely by clinging to one side of the blade with his walking surface, extending his fore part and bending it down over the other side.

He is threshing out fir-tree cones, in order to send the seeds to an experiment station

"Better Babies" for Trees

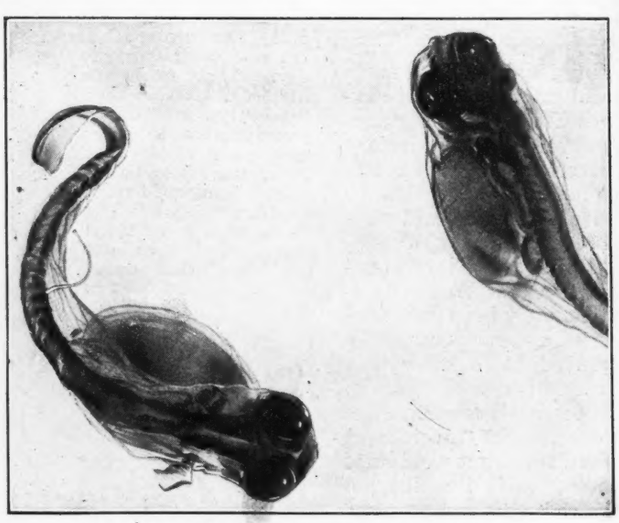
EUGENICS enthusiasts have lately turned their efforts toward the unprotesting trees. The Douglas fir tree has been selected for experimentation by Forest Service departments both here and in Europe. Cones have been gathered from old firs, young ones; sound firs, diseased firs; trees growing in the open, trees growing close together; trees growing on high ground, on low ground; in cold places, in warm ones.

The cones, or sometimes just the seeds, are then sent to experiment stations, where the seeds are labeled, planted, and watched. A study of two-year-old seedlings points toward the following rules: Seeds should be planted in a warmer climate than that in which they grew; seeds from trees which grew in the open develop into larger, healthier saplings than those from dense-growth trees; the younger the tree and the richer the soil, the better the seed; seeds should not be planted in very high places.

Cod Might Crowd the Ocean

"IF all the eggs of a seventy-five-pound cod should hatch and grow to maturity, the ocean would soon become packed solid with codfish." There is, however, a loss owing to the peculiar manner in which the eggs are laid, the dangers which they must encounter, the fact that many of them are never fertilized, while great numbers are thrown on the shore by the waves. The greatest loss is in the vast numbers eaten by fishes, birds, and invertebrates. The ovaries of a twenty-pound cod have been computed to contain 2,700,000 eggs, and a seventy-five-pound cod, 79,100,000 eggs.

In view of the fact that the eggs are eaten by an innumerable host of animals, the codfish turns the tables by eating almost every thinkable thing. The list of articles found in cods' stomachs includes shells, oil-cans, finger-rings, stones, corn-cobs, rubber balls, and every conceivable kind of mollusk and crustacean.



At this stage in his career—he is only three days old—a cod may have several million brothers

Less Speed and Power or Better Roads—Which?

By J. E. Pennybacker

If it were not for good roads the automobile truck would have to be retired in favor of mule-power

SPEED, power, and capacity are fundamental qualities of the motor-truck. Without them it would fail in its mission as a useful servant of man. The same reasoning applies to the development and use of the huge freight locomotives on our railroads; but in the case of the locomotive there is a coordinated development of rail and tie and ballast. The railroad man understands the folly of running a mogul engine on a light-ballasted forty-pound rail; for he knows that the outcome would be disastrous to the railway, the rolling stock, and the rail revenues. Furthermore, the railroad man doesn't use mogul engines on the entire system, nor does he lay hundred-pound rails on the entire system. He figures it all out from the standpoint of traffic needs and earnings. He has not hindered the full development of the locomotive by this coordination. Rather, he has fostered the development by holding it to economic lines.

Why not apply the same policy to the motor-truck, and seek by a coordination of truck, highway, and traffic to make use of the speed, power, and capacity of the truck along sound economic lines?

Few Existing Highways Adequate

It is self-evident that exceedingly few existing highways can long sustain the heavy trucks now in use. Reconstruction of the highways means widening of the surface, lengthening of the radii of curves, thickening of the road crust, and in some cases the replacing of bridges. For a long time the standard width of road surface or crust on country highways has been sixteen feet. Now, the width of the largest trucks is frequently eight feet. Manifestly, therefore, a heavy trucking highway must have an absolute minimum width of surface of eighteen feet and preferably twenty feet. Wide curves are often obtained only at great cost, but safety of life and limb on heavily traveled motor highways demands them.

Need for Thicker Road Crusts

The road crust must be very much thicker than would be required for light motor-truck and general traffic.

Little bumps to dangerous hollows grow. The remedy is to make the road crust thicker

This is required by reason of the tremendously increased shear, pressure, and impact of the heavy trucks.

Making the tire wider as the weight of the truck increases doesn't entirely solve the trouble, for the reason that as tire widths, whether they be four or fourteen inches, are relatively small as compared with the width of the pavement, it may fairly be assumed that the truck weight is concentrated on the entire road crust as a slab to support it if the type of construction be monolithic in character.

That the shearing effect of the motor-truck on the road crust increases at a greater ratio than the weight may be shown by the following example.

Explanation of Shearing Effect

Assuming two thirds of the weight of the truck on the rear axle, and that a constant weight on the tire is desired, it would require four-inch width tires for a five-ton truck and thirteen-inch width tires when gross weight of truck and load is fifteen tons. The contact of the tire with the pavement would then form a rectangle whose perimeter would be twelve inches for the five-ton truck and thirty inches when gross weight of truck and load is fifteen tons.

Thus, while the weight increases three times, the shear area increases only two and a half times, and the

The miracle of mechanical ingenuity that is the modern automotive vehicle cannot be efficient on roads like this

Few existing highways can stand up under the punishment they get from heavy trucks. Shall we have less power or better roads?

destructive effect is concentrated into a relatively smaller space.

As the effect of the heavy truck extends through the road crust to the sub-grade, the crust should be so designed as to distribute the concentrated load of the truck to keep within the bearing power of the sub-grade. It is generally held that the pressure of the weight is transmitted through the road crust at an angle of forty-five degrees in the various types of crushed stone and gravel crusts.

The wheel load of eight hundred pounds per inch width of tire delivered by a four-inch tire on a five-ton truck would be distributed over an area sub-grade of 192 square inches with a road crust 6 inches thick. A fifteen-ton load with thirteen-inch tires would be supported by 308 square inches of the sub-grade, or a little over one and a half times the area supporting the five-ton truck. Thus, while the weight is increased three times, the bearing area of the sub-grade is increased only one and a half times. Certain types of crust may serve to vary the angle of pressure, but the comparison of ratios of weight and pressure would not thereby be changed.

If two trucks met here, one would have to leave the road. The minimum road crust should be from eighteen to twenty inches and wider curves must replace sharp ones

These problems of shear and pressure must be met by substantial thickening of the crust. This thickening is also necessary to withstand the destructive effect of heavy impact which comes from the pounding of the heavy truck moving over inequalities and dropping from slight elevations. This action can further be neutralized by providing a smooth surface, but again this increases cost.

For the purposes of heavy trucking a highway will cost probably double that of a light traffic highway. Now, if the truck is not to be hampered in the development of its usefulness, and if the cost of the highway runs well up into the tens of thousands of dollars, what's the answer? Why, do as the railroads have done—pick out the heavy haulage routes, and form a system plainly designated under law and regulation, marked and posted as to class, weight, and speed, so that "he who runs may read"; and then, as rapidly as these heavy trucking routes are laid out, make provision to build them to stand the heaviest weight and the greatest speed found by truck-users to be really economical. Keep the heavy trucks off the light traffic roads—there's nothing to be gained by ruining the road and stalling the truck.

In designing the highway, this important consideration must not be overlooked—that, whereas the railroad can take up its light rails and substitute heavier ones, strengthening the highway is a much more serious matter. The new heavy truck routes should be designed to sustain a known gross weight, of a known distribution, known dimensions, and definite speed limit. The justifiable limits, according to the best advice, may be put at gross weight twenty-eight thousand pounds, weight per inch width of tire eight hundred, width over all eight feet, height twelve feet, speed fifteen miles on solid tires and twenty-five miles on giant pneumatics.

Got a Match?

NEXT time you "light up," think of this:

About 10,000 matches are scratched in this country every second that passes, and of these 95 per cent are used by smokers to fire pipe, cigar, or cigarette.

The man whose head for figures turned out that information also estimates that the time lost by the smokers in lighting matches—not in smoking—is worth $513,024 each eight-hour working day.

He arrives at his estimate by figuring that it takes fifteen seconds to scratch a match and use the light, and that 213,759 men whose time is worth thirty cents an hour are holding matches at the same time, thus losing golden minutes at the rate of $1,068 a minute, or $64,128 an hour.

No one, so far as we can learn, has figured out how large a percentage of the match-scratchers throw away the matches while they are still burning; but it has been estimated that a half of the fires which cost the United States $250,000,000 a year are caused by carelessness.

Wood, phosphorus, chlorate of potash, rosin, whiting, and powdered flint are the makings of this little device.

What Ho! The Land Canoe

THIS inventor, John Queen Slye, must have been a brother to the little girl who asked that immortal question, "Mother, may I go out to swim?" for when he decided to invent he reasoned as that mother did. He built a first-class canoe and then put it on wheels. The excuse he offers is exercise. A canoe on water is easily steered and moved, so that paddling develops grace but not muscles. But when you put your weight and the canoe's on four wheels and then try to move, grace ceases to figure and muscles begin.

He gets all the fun of paddling his canoe without the danger of a drenching

The steering and moving mechanism is much like that of a tricycle, handlebars above and pedals below. But in this wheeled canoe their functions are reversed. You steer with your feet and move by working the handlebars back and forth. Your feet fit into shoes that are connected by extension rods to the front shaft. By moving your feet back and forth in opposite directions, you steer. By moving the handles, the shafts to which they are attached are rocked. This movement is imparted to the gears and so on to the rear axle.

The front end of the canoe is loosely connected to the mechanism, so that it moves up and down as if passing over waves instead of over sidewalk. The seat moves, too, as the rower works. With all these movements by him and the canoe he is sure to be well exercised. Of course if he prefers to take his exercise this way, that is his affair. As for us, we prefer tennis.

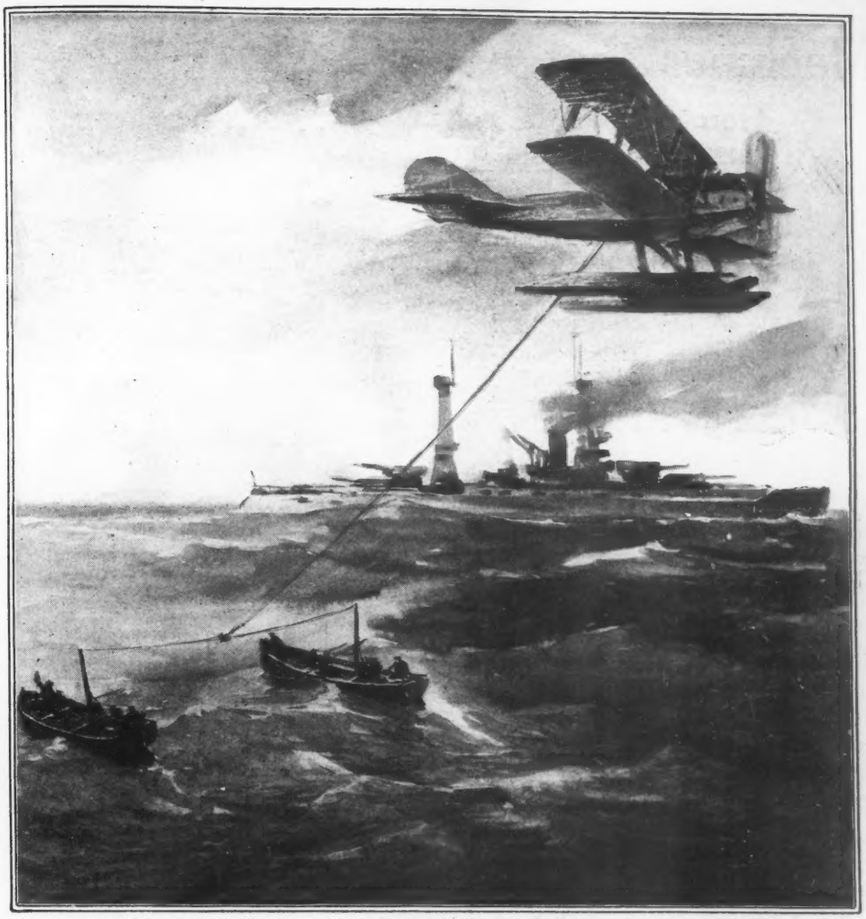
Exchanging Mail-Bags on the Fly

As you stand on the railway platform, waiting for your train, an express train flies by. Suddenly a man standing in front of you ducks, and something whizzes past your head and lands in a puddle six feet away. It is a bag of mail. As the station agent drags the dirty, heavy bag away, you thank the god of chance for your narrow escape and wonder doubtfully if that method of delivery is the best.

The Southern Pacific Railway has been wondering about it for a long time, and has lately decided to try out a new method. At each station a cement stand has been built near the tracks. On top of this stand are mounted a pair of curved arms with horn-like ends. Just beneath the place where they cross there is a straight arm with a ring attached to its end. The outgoing bag of mail is hung on this ring.

The train approaches at the rate of fifty miles an hour. Out from its side hangs a mail-bag. This bag is to be exchanged for the one hanging on the stand. As the bags near each other, a hook extending out from the mail-car runs through and detaches the ring on the arm of the stand. Both the ring and the bag land on the floor of the car.

At the same time, the horn on the stand passes through the ring on the car to which the car's mail-bag is attached. Off come the ring and bag, swinging around on the horn. The horns turn up at an angle and so absorb the shock.



The grappling-iron at the end of the cable clutches the rope and drags it and the mail-bags away. The aviator then winds up the cable and hoists the bags on board

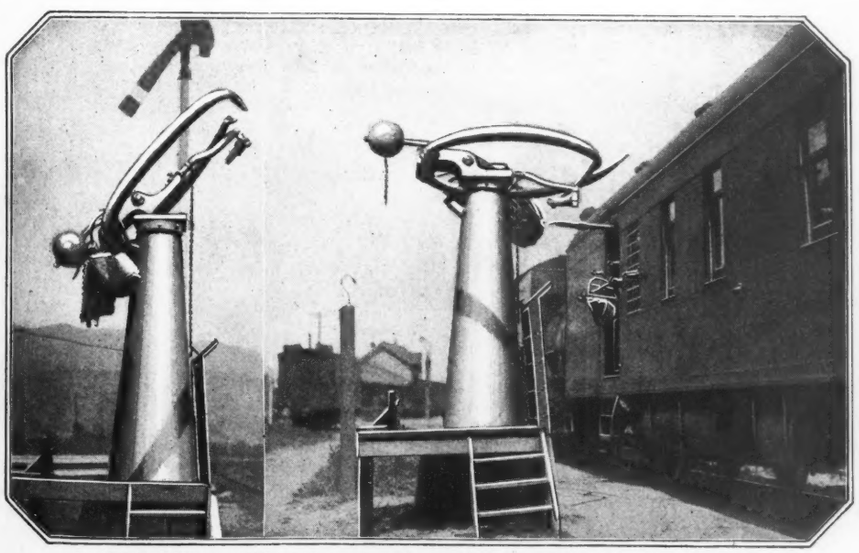
Mail Your Letters in the Ocean

ARE you annoyed at the very poor mail service we are getting now? Then join the Navy. Write your letters on board ship, and a seaplane will come along, grab them up, and rush them to port at the rate of sixty miles an hour. That is the Navy's latest plan and it has been tried out successfully.

The mail is collected and put into two sixty-pound waterproof bags, and the bags are then tied together with a fifty-foot rope. Two rowboats—each having a ten-foot mast—are stationed in the water about thirty feet apart. The rope is stretched across the masts, and fits into notches in their tops. Ten feet of rope, with the mail-bag on the end, hangs down into each rowboat.

The aviator flies over, trailing behind him a rubber cable with a four-pronged grappling-iron on the end. The grappling-iron clutches the rope between the rowboats, and drags it and the bags away. The cable is attached to a drum, and so the aviator simply winds the drum to hoist the bags on board.

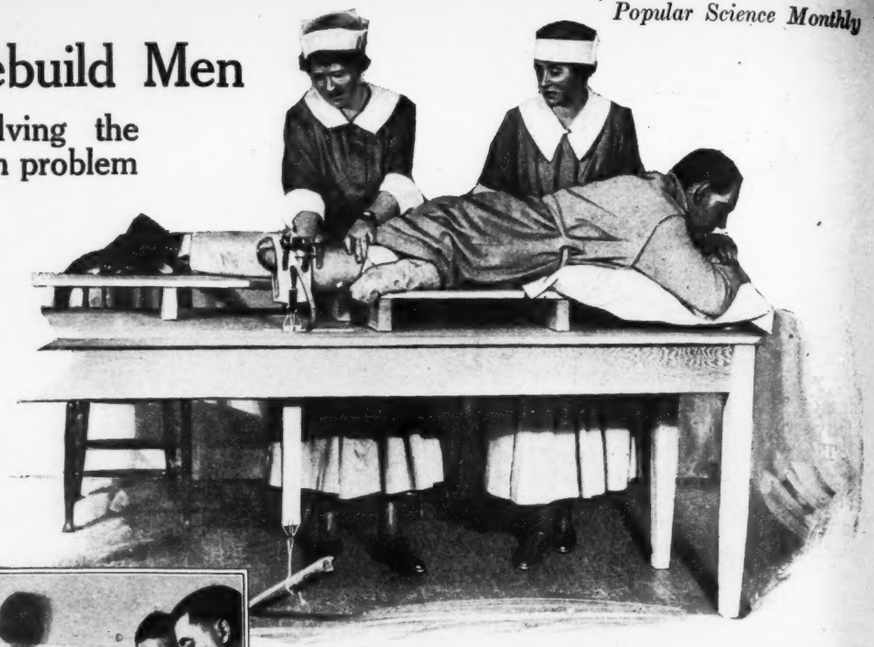
As we see opposite the railroads too are trying their best to improve conditions. If the Army will add its help to the Navy and the railroads, the Post Office will simply have to improve.



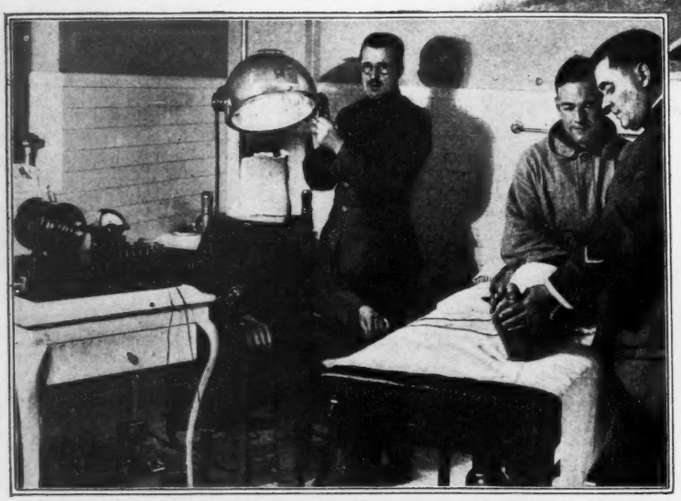
(*Right*) The mail-bags have just changed places. The bag that hung on the stand is now entering the fast-moving train ; the bag from the train is swinging around the arm of the stand. (*Left*) As the bag swings around one arm the arms turn up at an angle and so absorb much of the shock

Machines that Rebuild Men

How science is solving the human reconstruction problem

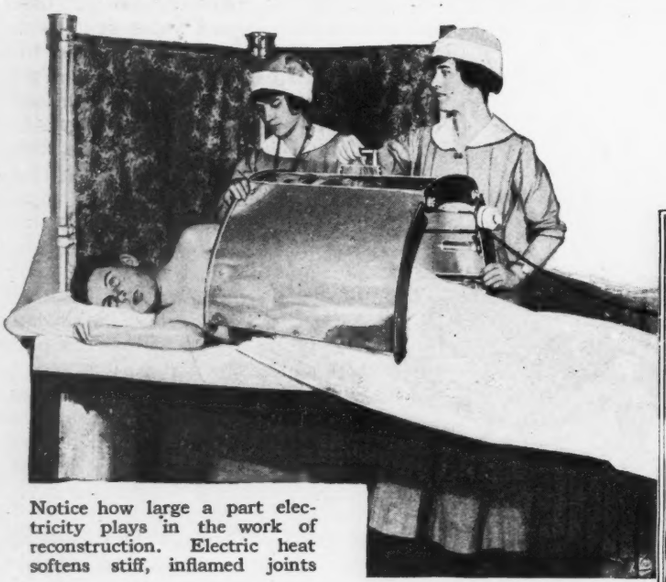


One leg is better than none; but when the reconstruction experts at the Letterman General Hospital in San Francisco are through with this soldier, he'll have an artificial mate for the surviving member of the original pair that will do everything except react to a pin-prick

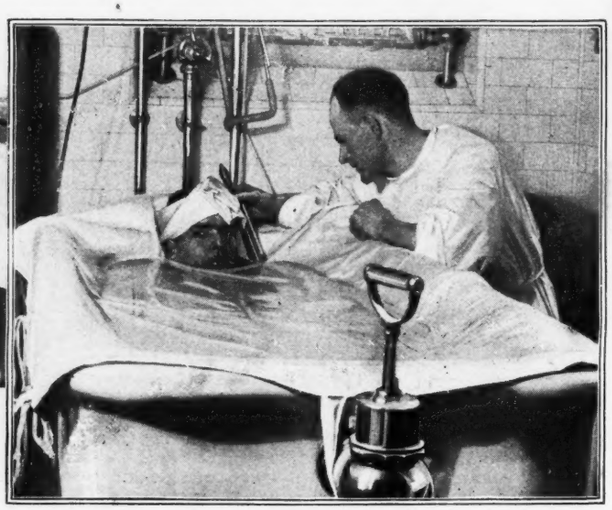


Not a diver's dress of a new kind, but the latest thing in ultra-violet lamps. The ultra-violet rays in the sun are what cause sunburn. The patient here will have an artificially sunburnt scalp; his circulation will be stimulated. The man on the table is trying the effect of electricity on benumbed muscles with excellent results

Queer little cells that receive the patient's body and leave his head outside. It's the electric-bath part of the great system of rebuilding those men that war has wrecked



Notice how large a part electricity plays in the work of reconstruction. Electric heat softens stiff, inflamed joints



Giving the water cure to a man whose nerves are war-wrecked. The patient remains in the bath for hours at a time. His attendant is taking the temperature of this strange bed

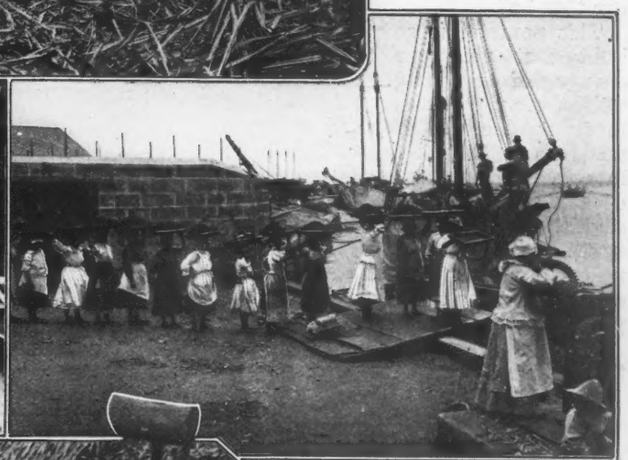
Everybody Works but Father

These various "Lindys" are really not so sweet as the sugar-cane by which they are surrounded. But the fault lies in their heavy jobs. They cut down the cane with machetes, stack it on wagons, take it to the windmill in the rear, and then squeeze the juice out between rollers

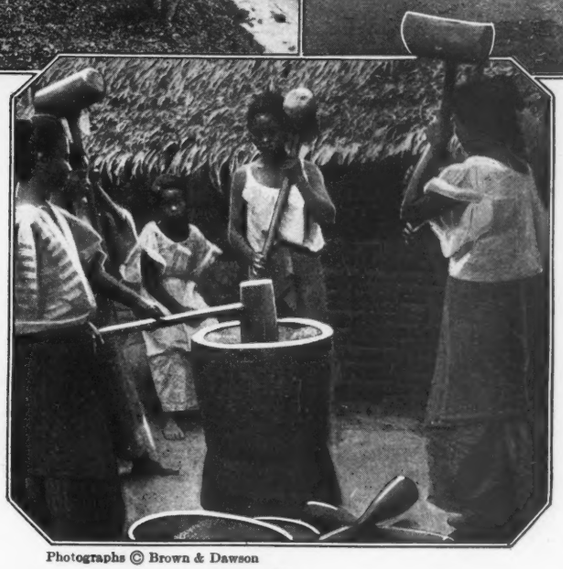
War did not create conductorettes. The woman above has been collecting fares on a Chilean trolley car for many years. Each time she collects a fare she tears off a receipt from the roll around her waist and gives it to the passenger. Later she takes up receipts and collects another round of fares

Servants in the house? No, in the street. These barefoot women are street-cleaners in San Domingo, who gather up the dirt with brooms made of branches tied to sticks. They consider themselves quite fortunate in getting such easy jobs, for the women of the West Indies do all the heavy work

Do you drink cocoa? Then you will be interested to know that these very women may have done a barefoot dance on some of the cocoa beans from which your cocoa was made! They dance the coating off the bean and make it smooth and shiny



This place is Trinidad, the island whence asphalt comes, and these women are natives. What are they doing? Only coaling a ship. They go to the coal-yards with their pans, fill the pans with coal, and then carry them over to the ship



"Frailty, thy name is woman!" So said Shakespeare. It is quite evident from the picture to the right that Shakespeare never paid a visit to the Philippine Islands

The women of the Philippines are hard workers. When they do have a few spare moments to rest in they pick up large wooden mallets and hull rice for preparing food

Photographs © Brown & Dawson

Building a Railway Bridge on a Boat

The tide rises and falls, but the train speeds along at an even level

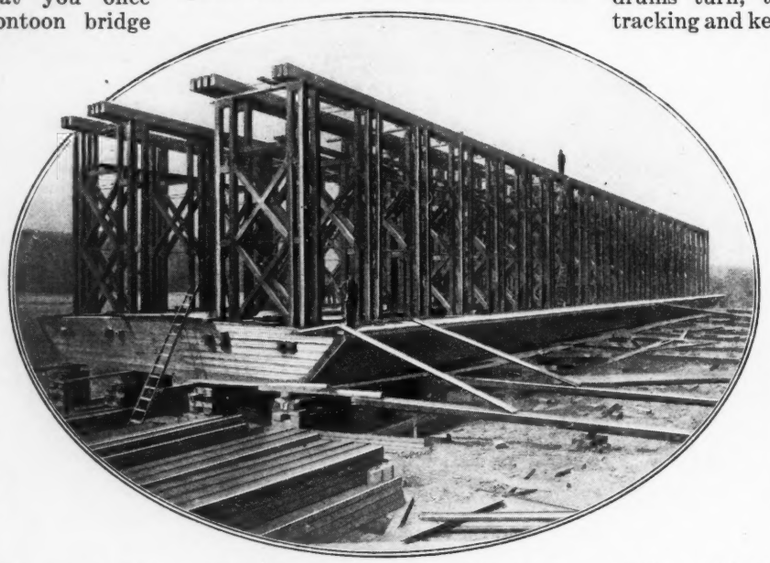
By P. Schwarzbach

AS you ride through Prairie du Chien, Wisconsin, you hear your fellow passengers talking about the pontoon bridge you soon will cross. At the word "pontoon" you automatically mumble something about Xerxes crossing the Hellespont and try to remember what you once learned about that pontoon bridge he used.

A pontoon bridge is a bridge built on boats, rather shaky and dangerous—a degree better than nothing in an emergency. It is often made simply of planks laid across rowboats which are placed side by side. While in alarm you imagine your train swaying and finally falling off into the river, you find yourself already crossing the bridge. No jerks, no wabbling, nothing unusual about it! How can that be?

This pontoon is so built that tide variation, and the change of buoyancy due to the weight of the train, are absorbed in its mechanism. Instead of being made up of several boats, it is built in one. The pontoon is a double-decker. On the lower floor is the steam engine, with its drum, that opens and closes the bridge. This is done by means of a heavy steel cable which connects the west end of the pontoon with piling in the river.

Between the lower and the upper floors there are nineteen columns, each of which contains twenty-eight blocks seven inches thick. The tracks are on the upper floor. As the tide rises some of the blocks in each column are gradually removed by hand. The space between floors is thus shortened just enough to make up for the tide rise. The blocks are put back when the tide goes down. This operation keeps the level of the tracks above constant. The number of blocks taken out during each tide rise depends, of course, on the kind of tide; the greatest number are taken out at flood tide.



This pontoon bridge, when finished, will have two floors: an upper floor, to hold the railroad tracks, and a lower floor, to carry the mechanism that will keep the pontoon in a constant position

When the blocks are taken out, six motors on the lower deck, which are run by a turbine-driven dynamo, turn drums that stand beside all the columns of blocking. Wire cables attached to these drums extend up and over pulleys which are mounted on beams on the upper floor. As the drums turn, the cables lift up the tracking and keep it up until the blocks have been removed. Then the cables are unwound and the tracking slips back into place.

The tracks on the pontoon are nine inches higher than the tracks on the pile bridges on either side to which they are hinged. This allows for the sinking of the pontoon when a heavy train crosses it. The tracks approaching the pontoon bridge have a downward incline of nine inches to make transition smooth.

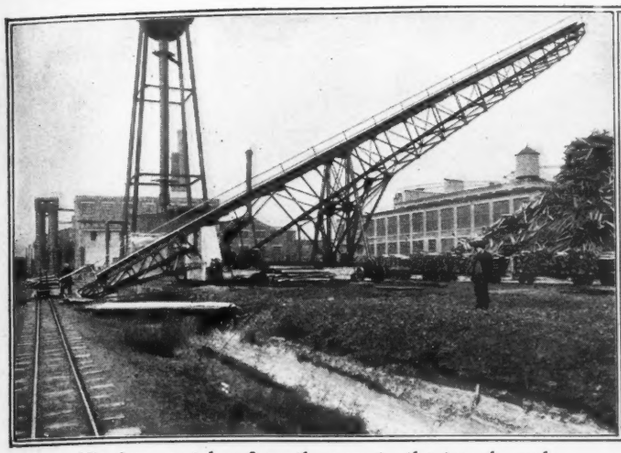
The boat itself is 274 feet long, 56 feet wide, and 6 feet thick. The wood in it was treated with many tons of creosote to keep it from rotting. This pontoon is opened only for very large boats. All small ones must go through spans in the pile bridge built at the east end of the pontoon.

From Prairie du Chien this bridge goes over the Mississipi to Iowa. You may think it a clumsy way to build a bridge; but the Chicago, Milwaukee & St. Paul Railway does not agree with you, for it is building many bridges after this pattern.

This man has pulled blocks out of pontoon bridges for thirty-five years; the blocks are taken out to allow for the tide rise

The tracks are raised by drums and cables when it is time for blocks to be taken out; this takes the weight off the tops of the columns

Up the Incline, Over the Top, Down to the Wood-Pile



The logs are taken from the cars to the trough, and moved by an endless-chain arrangement up the incline

When they reach the top of the trough the logs drop off and make a pile against the door of the paper-mill

WHEN you "dip the dip" on a scenic railway, you are first carried slowly up an inclined track to the top, and then you are unceremoniously dropped. That is just the sort of treatment these logs are getting. They have come on freight-trains to the paper-mill, and they are being unloaded. A man at the bottom of the inclined truss takes the logs from the cars and puts them in a trough, where an endless-chain carries them up the incline. When the logs reach the top of the truss they drop off and make a huge wood-pile at the back door of the mill. The back door is opened, and the logs are taken in, turned into wood-pulp, and later into paper.

This log-stacker, as it is called, is mounted on wheels that fit on three rails. One wheel is near the bottom of the truss, and the tracks on which the other two rest are thirty feet away, near the raised end. This makes the log-stacker, though large, movable.

The single wheel, sixteen feet beyond the bottom end, is enclosed in a heavy concrete counter-weight which keeps the truss from toppling over.

The endless chain on the incline is run by a twenty-horsepower motor. On this chain there are projections every four feet to keep the logs from slipping backward.

Gather Ye Strawberries in a Tray

With this tray hanging around his neck, the berry-picker can use both hands

STRAWBERRIES, dewberries, blackberries, must all be gathered by hand—usually one hand, for the picker needs his other one to hold the berry tray. If he could pick with both hands he'd do twice as much work. But what shall he do with his tray? Hang it around his neck, just as the man in our illustration has done.

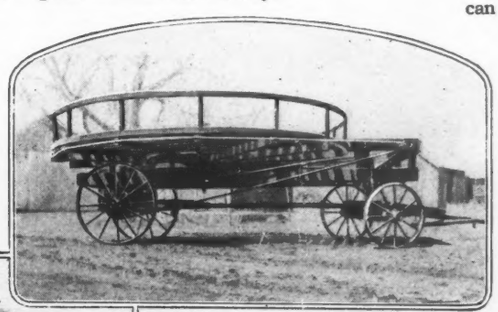
The tray fits in a holder that hangs by means of a rope around the picker's neck. As he leans over to pick, the tray swings forward and he drops the berries into it. When his tray is full he takes it out, places it on the ground, picks up an empty one, and goes on with his work. Boys run up and down, supplying the men with empties and rushing away with full ones.

When berries are harvested in great quantities for canneries, evaporators, or juice factories, the work must be done rapidly, so that all the berries will be in the same stage of development. For instance, the berries used in evaporators must be very ripe before they are picked. If the picking were done slowly, many of them would ferment and become useless.

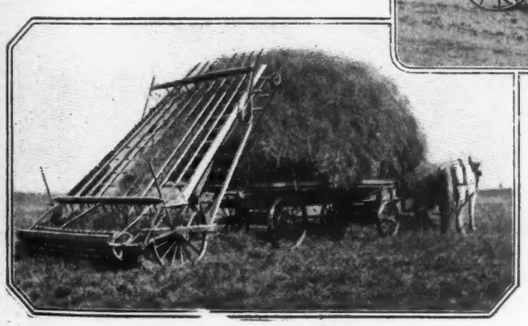
Getting In the Hay

HERE'S one way of making hay while the sun shines which necessitates no pitchforks, elbow grease, and sunburn. The hay-rack has a revolvable circular body which is connected by a series of pulleys to the hub of one of the wheels. Then, when the wagon moves and the wheels go round, the body revolves.

Trailing behind the wagon is an endless-chain conveyor having upright and crosswise slats. The crosswise ones do the moving. The hay is scooped up between them and rides up to the top, whereupon it falls off into the wagon. Thus the hay loading goes on automatically.

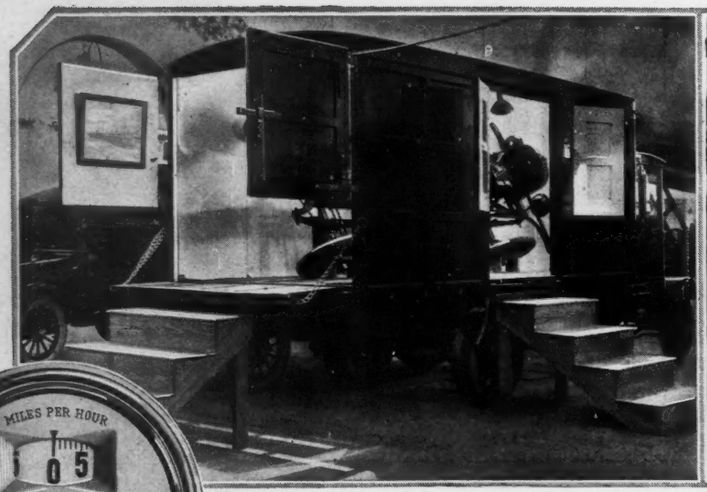


The hay-rack has a revolvable circular body which is connected by a series of pulleys to the hub of one of the ground wheels



The hay is scooped up between the slats and is carried up to the top of the loader whereupon it falls off into the wagon

New Accessories that Keep

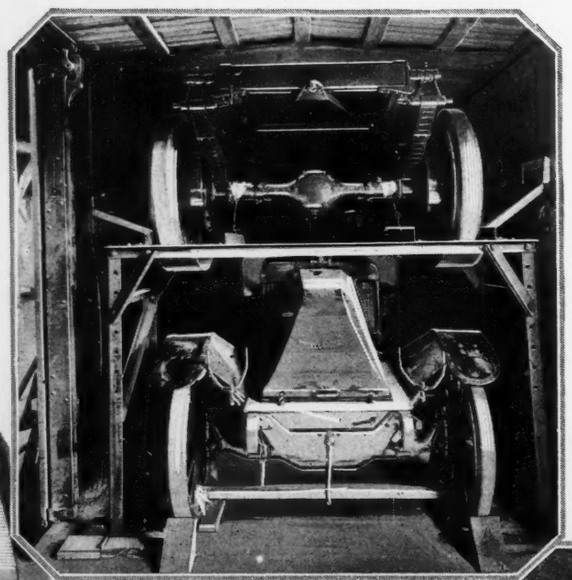


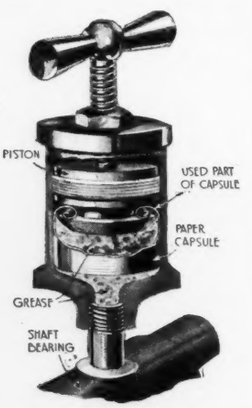
The small truck chassis tilted at an angle inside the lighted interior of the large show truck allows a first-hand examination by prospective buyers

A wash-boiler, a short length of rubber tubing, and water are all that is necessary to flush the truck's storage battery, provided the body floor has a trap-door

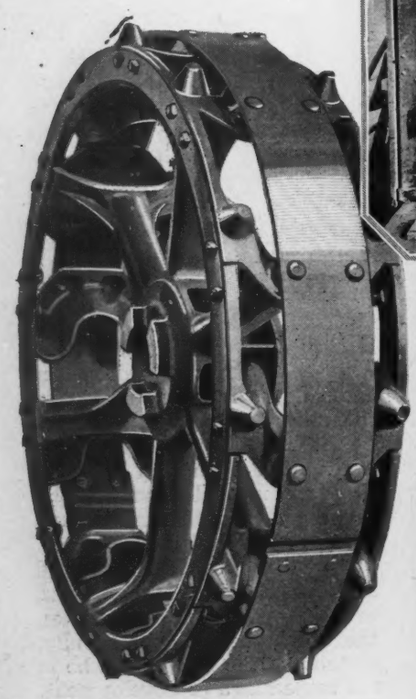
The combination speedometer and clock helps simplify the dashboard. The clock is wound mechanically by the speedometer shaft

Right—The full box-car height is utilized by simple metal stanchions which permit the loading of two trucks in place of one





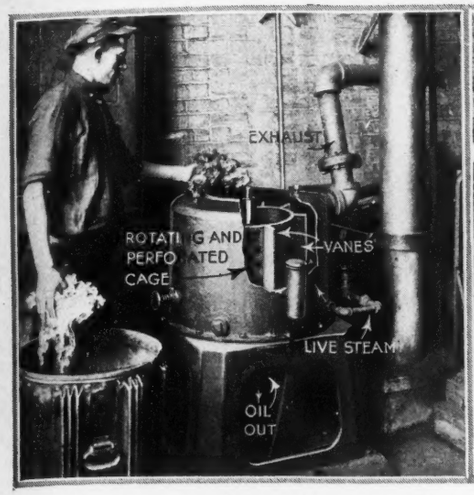
A paper capsule full of grease is set into the grease-cup, eliminating dirty hands and clothing



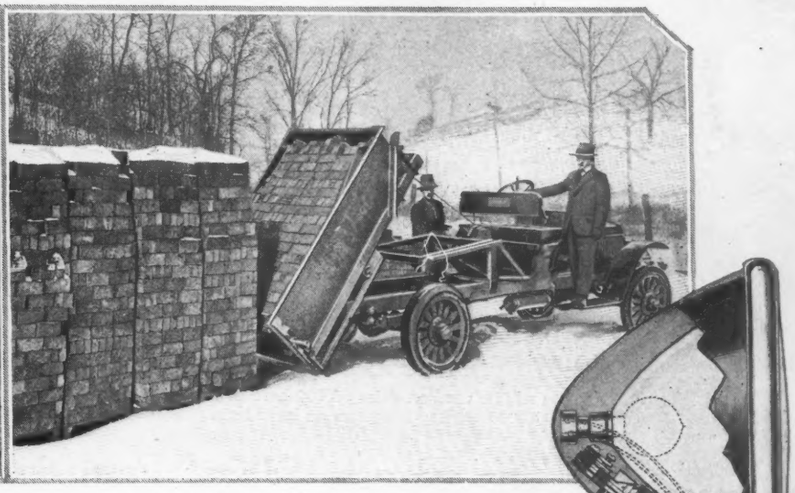
The unusual form of open tread on this tractor wheel gives greater traction and is self cleaning. The three-piece band may be removed in about ten minutes

Its low-built body dumps the load by gravity, which is an advantage over old-time body methods

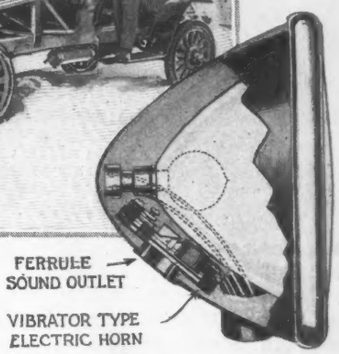
Down Automobile Truck Expenses



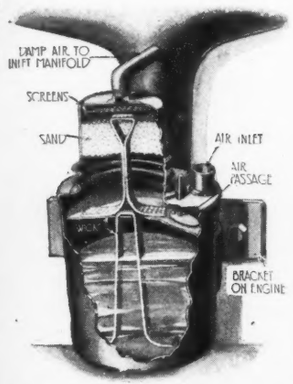
The steam washing-machine pictured above cuts expenses by cleaning dirty and oily waste. Where there are a large number of cars this device is a real money-saver



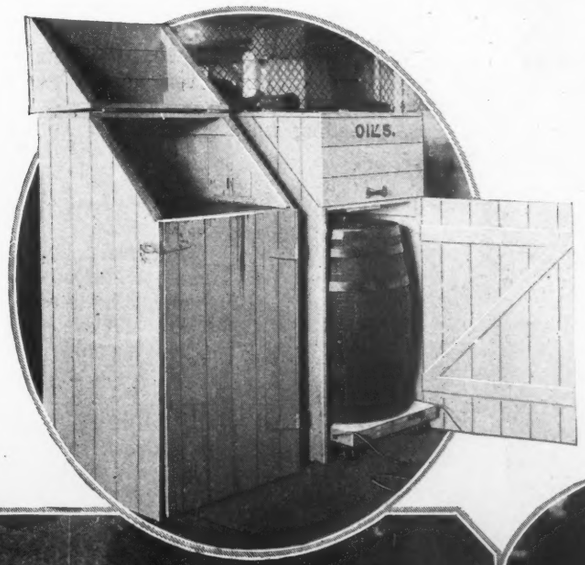
A new type of truck body which dumps and piles bricks at one and the same time requires only two men, thus conserving man power to a decided degree



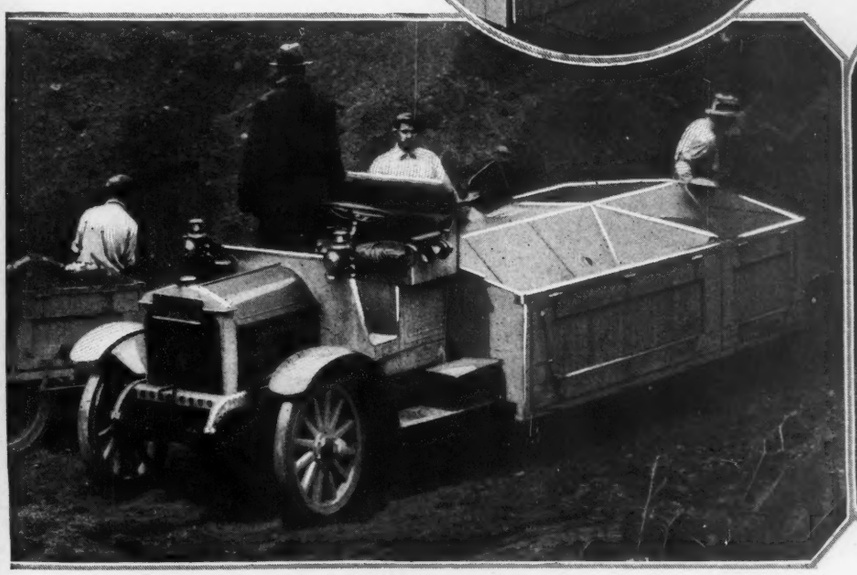
Enclosed in the lamp shell, the horn is protected from dirt and oil and is out of the way at all times. The mechanism of the lamp may be of any type. With the vibrator type of electric horn the wires are threaded through the tubular member and its regular supporting posts with the lighting leads, no outside wires being required



This contrivance cleanses and moistens the air on its way to the cylinders, which helps keep them at their maximum efficiency



Left—With its little roller platform, the oil-barrel is rolled where it is needed. When not in use it is kept in a box which covers it from sight



This truck body is so divided into compartments that it measures the concrete or other building material and dumps the desired amount on the construction site

An enterprising garage-owner provided his men with a clothes-wringer to dry the wet chamois cloths used in washing the truck

Not a horse will be used on this 200,000-acre wheat farm, which is being worked by a corporation capitalized at $2,000,000. Fifty-two tractors have been purchased, and their plowing record is an acre a minute

The Biggest Wheat Farm in the World

WHEAT will be harvested next fall from one of the world's largest farms, comprising about 200,000 acres of Indian lands in Montana and Wyoming. The land is located on the Crow, Blackfeet, and Fort Peck reservations in Montana and Wyoming. To make this land productive, a corporation with a capital of $2,000,000 has been organized.

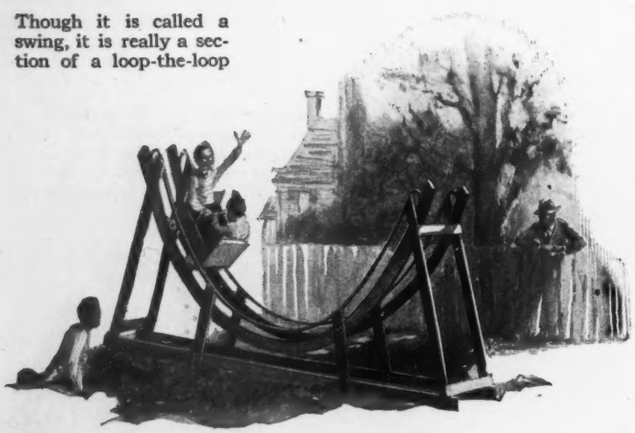
On this huge farm not a horse will be used. Fifty-two tractors are now the property of the corporation, and the plowing record for last summer was more than an acre a minute for the working time.

Each harvester will handle twenty-five acres a day, and enough harvesters will be put on each 5,000-acre unit to do the work in ten days. Forty-five days will be allowed for the plowing. Seeding will be figured in the same way.

In the last dozen years the Government has laid out irrigation projects along the river bottoms in a number of reservations. Many of these systems have been completed.

When the enterprise is fully developed it is expected that their irrigated lands will raise a crop every year, while the dry lands will raise a crop every two years. The average annual rainfall in Montana is only fifteen inches.

Though it is called a swing, it is really a section of a loop-the-loop



A Slice of Scenic Railway

THE father of this invention called it a "swing," but it is really a car that runs up and down on curved tracks, giving to its occupants the sickening feeling associated with swings. The tracks terminate rather abruptly, so that if the passengers get too frisky they are apt to topple out when the car hits the high spots.

The car seats two people, one at each end, facing each other. They have in common a handle which they mutually grasp when they want to start rocking. By straining backward and forward they set the car in motion. Gravity and momentum keep it going.

The car is guarded so that it won't get off the track. This is done by a second set of tracks just above the wheels. These two sets of tracks connect at their ends, so that the wheels won't slip out between them, thus preventing the car from plunging into space. The tracks are supported by curved beams, and both tracks and beams are fastened to wooden supports.

The Pushmobile that Will Never Stall

HE doesn't know anything about "dead centers"—the little boy in the picture below—but he does know that he likes his new pushmobile better than his old one; for his old one often stopped short when he was moving slowly, refusing to go until he got out and gave it a push. His new one never does this, for it can't get in a dead-center position. With every complete pull of the handle the gears turn a little more than half a cycle. This keeps them from getting on dead center, no matter how slowly the machine may be moving.

The dumping cart on the back of the machine is a new idea in pushmobiles. All boys—even those who wear socks and patent-leather shoes—love to cart loads of dirt to far-away places and dump them. The boy need only turn round and give the cart a push, and the dirt will pour out freely and easily.

No fear of this car stopping on dead center when the boy dumps his load

Tying Knots in Endless Ropes

A very old trick of the fake "mediums" exposed

By Hereward Carrington

CHORUS girls have worked out a single sentence which bursts with philosophy. Here is that summation of stage experience: "The smarter they are, the quicker they fall." Inelegant and ungrammatical, to be sure, but the truth.

Johann Karl Friedrich Zöllner, in the foremost ranks of Germany's astronomers and physicists, watching a simple sleight-of-hand performance in which knotted ropes figured, was entranced. Zöllner, who was clever enough to discover, among other things, that the sun is five hundred and seventy thousand times more brilliant than the moon, wasted hour after hour, studying the actions of Slade, whose chief claim to greatness was his ability to hide knotted ropes up his sleeve!

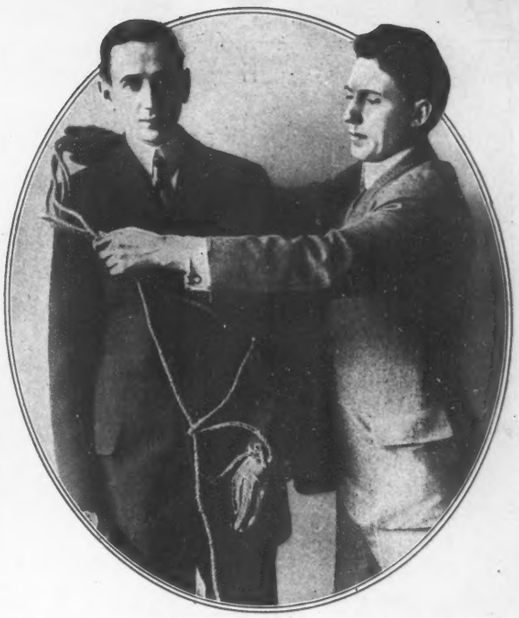
The Hand Quicker than the Eye

Zöllner was "buffaloed." Apparently Slade was able to tie knots in endless cords without the slightest difficulty. Zöllner thought that Slade accomplished the feat by resorting to some mysterious use of the fourth dimension, or by invoking some spiritual aid. Time after time, the Professor sat watching Slade, fascinated, spell-bound, trying to figure out in his mighty brain how that impossible trick of tying knots in endless cords could be achieved. And he died believing that Slade tied knots by some practical application of the obscure fourth dimension.

Now that the hoax is history, the childish simplicity of Slade's tricks is given to the public to smile over.

In all of his rope tricks Slade depended upon that lone principle of the sleight-of-hand expert—that the hand is quicker than the eye.

The simple beauty of all Slade's tricks is the ease with which an amateur can acquire them. To perform the first one, a piece of rope a yard long is prepared beforehand in the following manner. A number of knots are tied in the piece of rope, and the ends are knotted together. The rope is then tucked up the sleeve, with the knotted end just inside the cuff. The magician or spiritualistic "medium," now prepared, shows the spectator another piece of rope a yard long. He places the two ends together, ties them, and conceals the knot in the palm of the hand. He works down the knotted ends inside his cuff, and these he seals to the table; or he merely seals them together. The lights are turned out; he puts the rope he has shown to the spectator into an inside pocket of his coat, pulls the rest of the concealed rope from his sleeve.

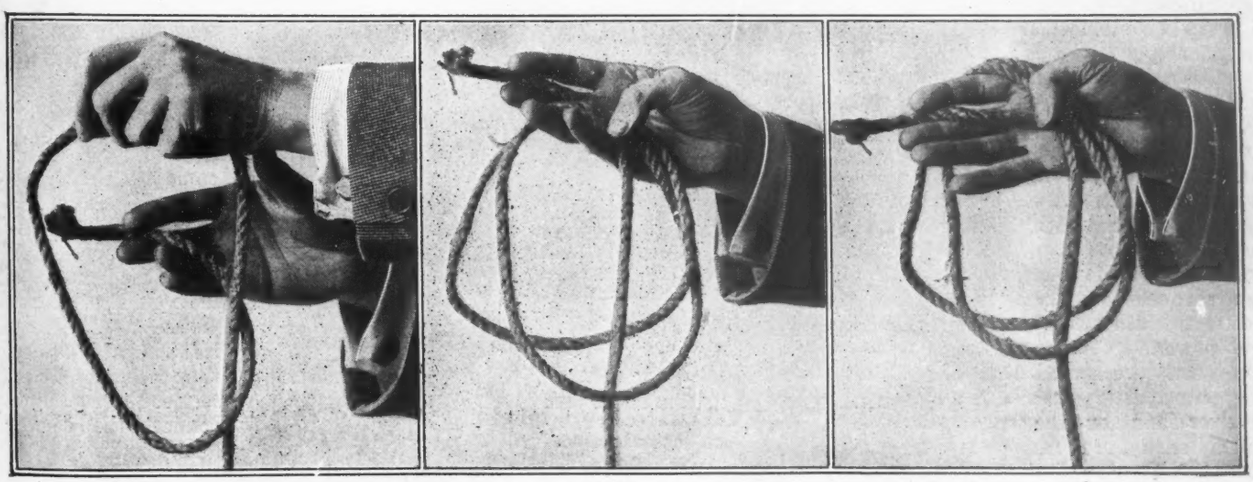


After tying the ends of a 30-foot rope to the wrists of two spectators, the medium makes loops in the center of the rope and passes them over the head of one of the spectators, whose wrist is tied to one end. There will be as many knots as there were loops

The knotted ends of the rope seen by the spectator are concealed in the palm of the hand, so that the end of the hidden rope may be substituted

Tying Knots in the Light

There is also a way to tie knots with the lights on. One end of the rope is held in the right hand about one foot from the end, and the rest of the rope is wrapped around the right hand until all the rope has been wound. The first end is then drawn through the loops, tied to the other end, and sealed. When the coils are taken form the hand there will be as many knots as there were loops.



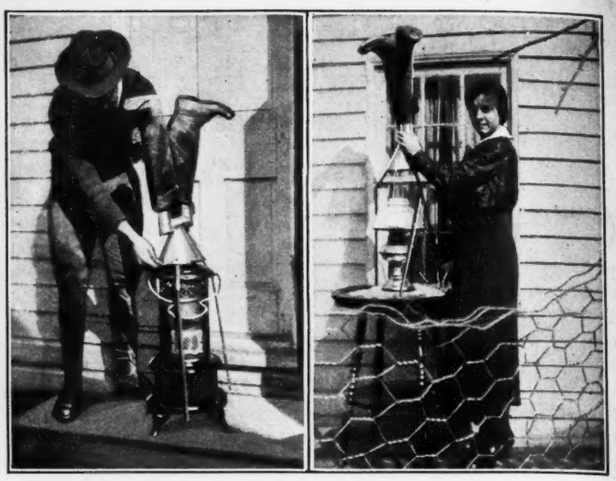
To tie knots in the light one end of the rope is held in the right hand and loops passed over the fingers, after which the two ends are tied and sealed. The manner in which the loops are made is an important detail in performing the trick

It is called a milker's mask, though it does not protect you from milk but from the whacks of a cow's tail

The Masked Milker

YOU are milking a cow. A fly bites her and she switches her tail around to chase it; but instead she unwittingly hits you in the eye. You grow angry and sit on her tail, whereupon she grows angry and kicks. Over goes the pail, out pours the milk—a day's labor lost—tragedy!

Frederick W. Elleby, of California, has been a sufferer for years. Many the lost pails of milk and the black eyes his cows' tails have caused him. The result? He has invented a face-mask for milkers. Catchers and fencers have them, so why not milkers? The mask fits over your face, under your chin, and fastens behind your head with a strap.



Heat rises from the lamp, up the funnel, up the tubes, into the boots, and dries them in a nice, gentle way

When Boots Are Wet

ON October 1, 1918, William Preston Grace patented a "device for drying rubber boots." Whereupon winter decided perversely to be mild and snowless so that nobody would want rubber boots or driers for them. But it will not e'er be so and Mr. Grace's drier will come into its own.

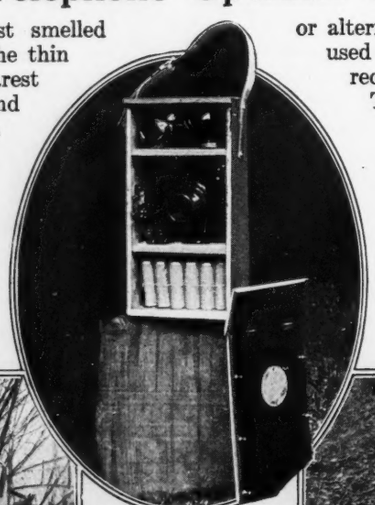
A funnel-shaped stand of tin is mounted on three legs. The top of the stand runs into two upright hollow tubes which are as long as the average rubber boot. Screening is spread across the ends of the tubes and then wire crowns are mounted on them. The boots are hung on the crowns and the stand is placed over a lamp or oil-stove. The heat rises up the tubes and dries the boots, but will not burn them.

The Horn Is Telephone Operator in the Forest

A RANGER walking through the forest smelled smoke. Just ahead of him he saw the thin clouds rising. A fire! He rushed to the nearest telephone line, attached his telephone, and rang. No answer. The men at the station had walked off and did not hear the bell.

In the ranger's telephone there was a klaxon horn. He connected it up and started it whirring. The noise echoed through the forest, and in a few moments a voice came over the wire. Help was sent and the fire was put out before it had gained any headway.

This combination telephone and signal horn is the invention of C. M. Allen of the U. S. Forest Service. It is made so compactly that it fits in a box which the ranger can carry with ease. On the bottom shelf of the box are six cells of dry batteries which furnish the power. On the top shelf are found the transmitter and receiver and on the middle shelf the horn. A special magneto furnishes either direct or alternating current. The alternating current is used for the ordinary ringing signal and the direct current is used for operating the horn. The box complete weighs thirty pounds.



In the box are: top shelf, the transmitter and receiver; middle shelf, the horn; bottom shelf, six dry-battery cells

The ranger calls his party by means of a klaxon horn. The instrument is carried easily

Somehow we cannot conceive of this valuable invention being wasted wholly on the forestry service and its fires. For instance, we know of innumerable apartment houses and office buildings where it could be installed with profit. Imagine being able to turn on a klaxon horn down on the first floor when the elevator boy won't come up! Or being able to send a shrieking call reverberating through the halls when the telephone girl goes away from her board and will not come back. You'd have everybody running—from the house superintendent to the janitor. A little service, James, please—a little service! And, James, next time we don't get service we're going to connect the electric lighting mains to that horn, and let it sound all forenoon.

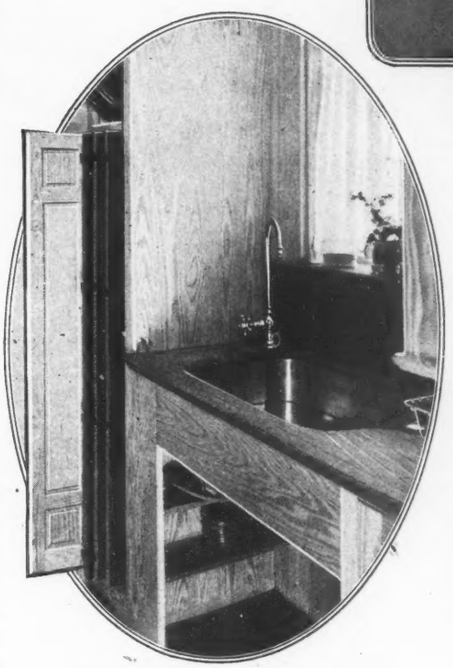
When the Table-Leaves Are Not in Use

TABLE leaves are useful things to have when you feed a multitude of friends, but when your friends have gone the leaves once more become a nuisance. You want to hide them, but if you live in an apartment you can't.

Your only hiding-place is your cellar "bin," and no padlock will hold itself responsible for the things that go in it; besides, table leaves would be cumbersome to get to and from the cellar on the dumb-waiter.

A leaf closet is the best solution of this problem. Its picture is shown here. It is built in such an inconspicuous place that it might easily be taken for part of the wall. After you put in the leaves you shut the door and forget all about them until the next momentous occasion arrives.

If you build your closet all the way up to the ceiling, the space that the leaves don't fill may be shelved off to hold other unloved necessities and household encumbrances.



Build a closet in your kitchen for holding your idle table leaves

Baby's Cradle-Bath-Tub Your Shopping-Bag

HERE is a new "three-in-one"—cradle, bath-tub, shopping-bag—made out of poles, ropes, and a cretonne bag. The object of all "three-in-ones" is efficiency. Observe!

Your child is sleeping peacefully in its cradle while you read the paper alongside. Suddenly you spot a bargain. You dump your child out, take the cradle from its stand, bend it into a shopping-bag, and rush out. You buy your bargain, hurry back, dump it out, pick your dirty child from the floor, open the bag, fill it with water, bathe your child, and then hang out the bath-tub to dry.

This cradle is made of waterproof cretonne so that it won't leak when it is used as a bath-tub. The colors, of course, must be fast, for the sake of your child.

You don't need the poles when you go shopping; and when there are no bargains, you might give your child a bath

The feathers are pulled out by rollers and then drawn into a vacuum tank

It used to take her the better part of an hour to do what this instrument does in a few minutes

It Doesn't Leave Even a Pin-Feather

LOTS of things happen to a chicken between the time it "clucks" around the barn-yard and the moment when you chew on its tender leg. Before cooking it the chicken must be picked—heretofore a long, tedious job, for a chicken has many feathers, which were pulled out one by one.

Now O. G. Rieske has invented a picking-machine, which pulls the feathers out in bunches and whisks them into a vacuum tank.

A six-pointed rake-like implement raises the feathers so that they touch a pair of rollers which revolve by electricity. The rollers pull the feathers out between them and pass them on to a tube which sucks them up into a tank. A small suction fan helps the work along by disposing of the feathers.

The Modern Bean-Shooter Slings Toy Airplanes

The monoplane is gliding back to its starting-point—the boy's sling

BOYS are constantly getting themselves in trouble by slinging stones at bald heads and window-panes. If it is simply a desire to shoot that prompts them, the airplane slinger shown here will cause them as much pleasure and fewer spankings.

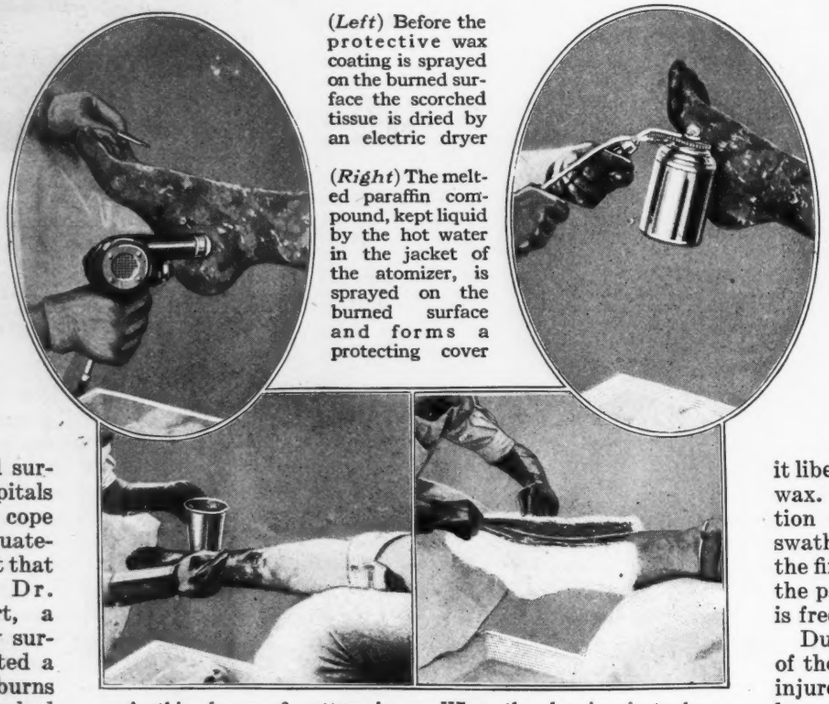
The wings are made of fan-shaped tough paper, supported by light metal stays. They are folded up close to the body of the plane before the plane is placed in its sling. When the boy shoots, the plane, with its wings folded, flies high in the air. It sometimes reaches a height of one hundred feet.

Not until it has reached the highest point in its flight do the wings open. Then a spring forces them out, and the plane glides gracefully to earth in wide spirals frequently landing almost at the shooter's feet.

Healing Burns without Pain or Disfiguring Scars

REMEMBER the excruciating pain which even a slight burn causes you, and then try to imagine the suffering resulting from a severe burn by which a considerable area of skin is scorched and destroyed. Such severe burns occur sometimes in factories, foundries, and mines, and are classed among the most serious injuries to which workers are exposed.

When the Germans introduced "liquid fire" as one of their weapons of attack during the great war, the Allied surgeons in the field hospitals found it difficult to cope with the task of adequately treating burns. At that critical moment Dr. Barthe de Sandfort, a retired French Navy surgeon, who had invented a method of treating burns by coating the scorched surface with an air-tight covering of medicated paraffin wax, presented his invention to the French military authorities and offered his services in administering the treatment and teaching others the proper method of applying it. He was given charge of a small hospital at Issy-les-Moulineaux, in Paris, to which all soldiers suffering from burns were sent for treatment. The results obtained from this treatment were so remarkable that it was adopted by the hospital staffs of all the other Allied armies.



(*Left*) Before the protective wax coating is sprayed on the burned surface the scorched tissue is dried by an electric dryer

(*Right*) The melted paraffin compound, kept liquid by the hot water in the jacket of the atomizer, is sprayed on the burned surface and forms a protecting cover

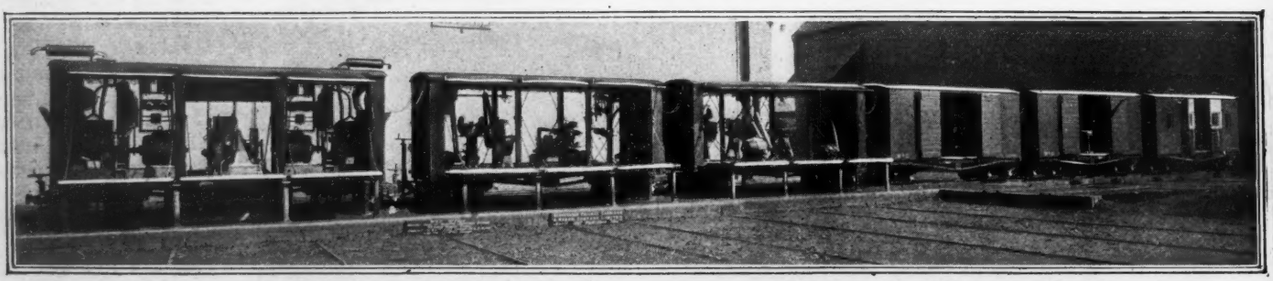
A thin layer of cotton is placed over the paraffin coating of the burned surface, and by painting it with melted wax it is made to adhere to the coating

When the dressing is to be changed it is ripped open with the scissors and it can then be peeled off without difficulty and without giving the patient any pain

The compound that Dr. Sandfort employs for covering burned surfaces consists of neutral paraffin, resins, and certain disinfectants. It has a low melting-point, and, when heated to 140° or 150° F., forms an amber-colored liquid which is either brushed over the surface of the burn or sprayed on. The hot liquid hardens quickly, and forms a pliable yet air-tight covering of the burned area. A thin layer of cotton is placed on the first coating of wax, and is made to adhere to it by painting it liberally with the melted wax. For further protection the coated part is swathed in cotton. After the first twenty-four hours the patient, in most cases, is free from pain.

During the first stages of the healing process the injured tissues secrete a large quantity of lymph, which collects under the shell of the dressing and prevents it from adhering to the tissues. The wax dressing may easily be lifted or peeled off without causing the slightest pain to the patient. The burns should be dressed every twenty-four hours for the first week or so.

Workshops that Travel on Wheels



Workshop trains like this, compactly arranged and equipped with electric power and machinery, were used by the Allies behind the Flanders front

DURING the intensive military operations along the Flanders front it was a matter of the greatest importance to keep the enormous technical fighting apparatus, the wonderfully efficient war machinery, in good condition. Repairs were constantly needed, and time was too precious to permit the delay that would have been caused by long transportation over difficult roads. The British War Office supplied six completely equipped military workshop trains which were operated on the narrow-gage military railways behind the front.

Each of these six trains consisted of six cars, including a generating car, two machine-shop cars, a tool van, a stores van, and an officers' car. The cars were all of the same dimensions, 17 feet 8 inches long, 5 feet 5 inches wide, and a trifle more than 9 feet high. The generating car was equipped with two 15 to 20 horsepower gasoline engines directly coupled to 10-kilowatt generators. The machine-shop cars carried drills, lathes, shaping machines, etc.

Can You Save a Drowning Man?

"HELP! I'm drowning!" You jump up at the cry, throw off your coat and vest, and dive in. Being a good swimmer, you are quite confident that you can save a life.

But live-saving is dangerous business. It is not sufficient to grab a drowning man with one hand and start swimming to shore with your other hand and your feet. If he is terror-stricken he will cling to you and pull you down with him. If you don't hold his head above water he will drown while you pull him behind you. So before you try rescue work you should learn how; for there is method in it.

The Red Cross Society gives you your choice of two excellent methods. In one you lie on your back and swim with your feet. This leaves your hands free to hold the drowning man above water by the ears. You use the scissor kick of the side stroke. In this stroke you draw your feet up close to your body, crossing them, and then kick down. This sharp kick propels you backward through the water.

If the person you are saving knows how to swim and is not frightened you can use a much easier method. The victim floats on his back while you grasp either his right or left arm, according to which side you swim on, and thrust your elbow under his back. This relieves him of much of the effort necessary in floating. You swim forward, using the breast stroke with your one unhampered arm.

If the drowning person struggles dangerously it may be necessary to stun him in order to save both your lives.

Lie on your back, kick with your feet, and hold the drowning man's head out of the water with your hands

If your victim is not frightened she will float if you help her with your elbow; then use the breast stroke

A New Use for Jack-Screws

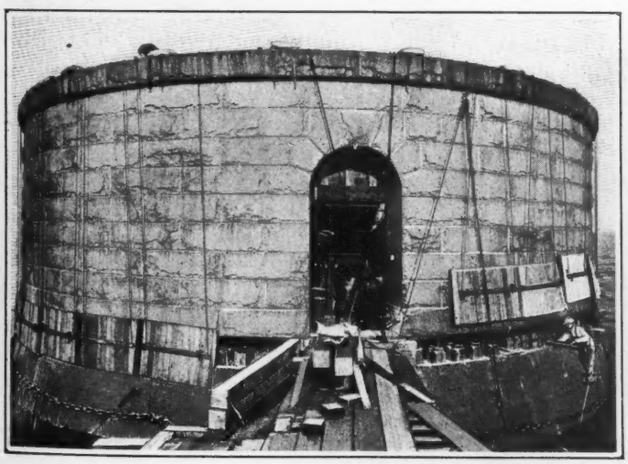
They were employed in setting straight a Chicago intake crib

AFTER the newest of Chicago's intake cribs, off the foot of Wilson avenue, had been completed, it was found that the stone superstructure was eighteen inches out of plumb. The ring-shaped superstructure, built of square-hewn blocks of granite, has an outside diameter of seventy feet at the top and ninety feet at the bottom, with an inner diameter of forty feet.

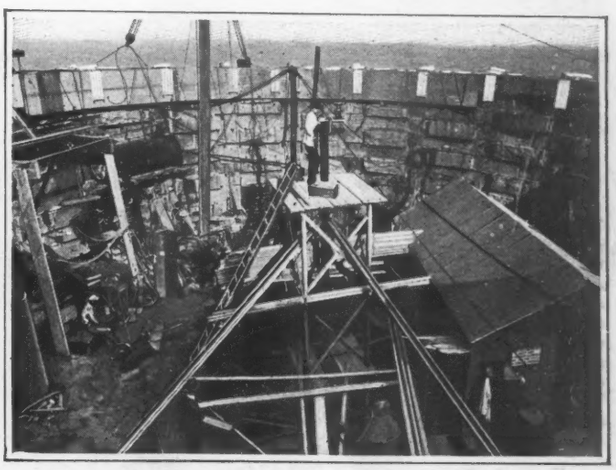
It rests upon a double-walled steel caisson filled with concrete, which was sunk to the bottom of Lake Michigan to form the foundation of the crib. The uneven density of the clay bottom caused the caisson with its superstructure—which alone weighs about 1,400 tons—to lean over.

To bring both the superstructure and its foundation back to a vertical position was not feasible because the foundation did not rest upon bed-rock. It was decided, however, to tilt the superstructure to a vertical position. This was done, not by rebuilding the ring of stone masonry, but by blasting away the layer of concrete by which the superstructure was joined to the foundation, placing a large number of jack-screws between the foundation and the ring of masonry, and by means of these raising the superstructure on the overhanging side and lowering it on the opposite side until the whole structure was again in plumb.

The concrete was blasted out by small charges of dynamite handled so skilfully that the masonry above was not hurt. To keep the waves from dashing in where the concrete had been removed, plank shutters, suspended by ropes, were placed over the open spaces. For leveling the superstructure three hundred jacks were used, which were manned by twelve experienced house-movers. Masonry underpinning was substituted for the jacks when the superstructure had been tilted to a vertical position.



As the concrete ring between the caisson wall and the masonry was blasted out, jack-screws were placed in position and shielded from the waves by plank shutters



The engineer on the platform in the middle of the structure directed the tilting operation by careful sighting with the telescope of his leveling instrument

The Daily Grind for Our Daily Bread

You can buy your own grains and be your own miller

"Time to get up," you think, when you hear the grinding of a coffee-mill. But the particular coffee-mill shown here is not grinding the morning coffee. In fact, it isn't grinding coffee at all: but wheat for bread. The thrifty housewife thereby saves the price of grinding and gets double service out of her coffee-mill

A few years ago this mortar and pestle pounded out things in the back room of a drug store; now the mortar and pestle have been transferred to the kitchen, where they are pounding out grain instead. Sufficient patience and power in using them will result in reducing grain to a powder fine enough for bread-making

By means of a meat-chopper the grains of wheat in the top picture were turned into whole-wheat flour for the food in the lower picture

The principle of the tub and poles for pounding grain is the same as that of the mortar and pestle shown above, but the proportions are different. There, a large woman pounded with a small pole; here, small children pound with large poles. The children are Filipinos and they are pounding rice

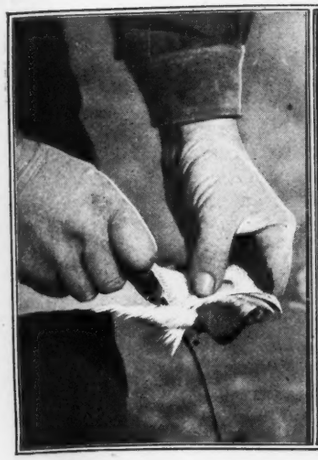
Surely the rolling stone in the picture above gathers no moss, though it may be gathering corn flour. Two firm brown hands are rolling it on another stone, and between the stones grains of corn are being crushed. The hands belong to a young Indian girl of New Mexico.

Boys who long for a country where they won't have to go to school are recommended to parts of China

This Chinese boy does not go to school, but he does have to spend several hours a day grinding corn

Champion Dresses a Chicken in Twelve Seconds

Clarence Hockings, the record-breaking chicken dresser, gives an exhibition of his speed and skill



Mr. Hockings does not chop his chicken's head off; neither does he wring its neck; he pulls the neck forward and slits it with a sharp knife just below the ear lobe

Then he ducks his chicken in a pail of water in order to wet the feathers, and plucks them, first from the left leg, second from the right, third from the left wing, and fourth the right

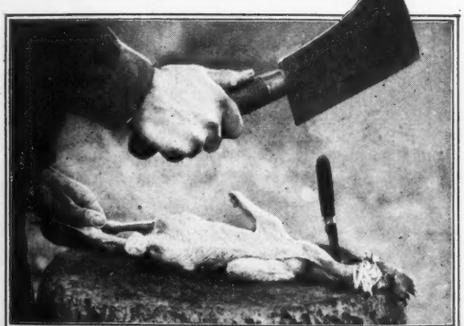
All the feathers he has gathered so far he uses in a great push which forces all the feathers on the chicken's back to retreat ignominiously into the pail

The victorious handful follows the back feathers into the pail, and the dresser's hands are free to gather in the breast feathers and any left on the wings

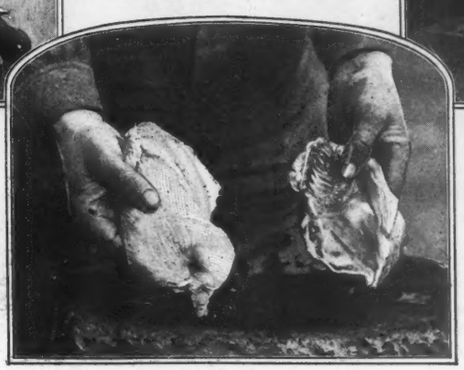
Clarence Hockings, the speed king at dressing chickens, catches his bird with a net and then takes it out by the feet ready to be killed. It takes the champion just twelve seconds to dress a chicken, only sixty being required from barn-yard to oven

Its final appearance will be in the dining-room under "Half a broiled chicken with dressing and green peas"

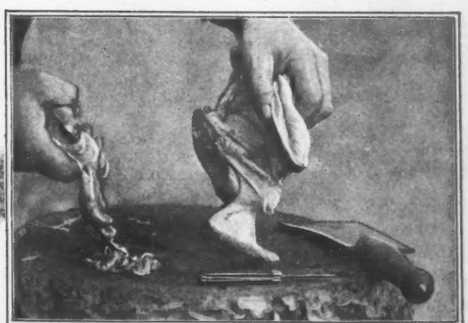
Off with his head even though he is dead, and an old-fashioned chopper is used; then the legs are amputated just above the knees

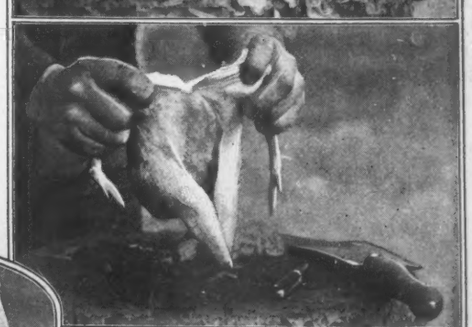


The backbone is the next thing to go. The chicken is turned on its right side and held by the left wing. Then the knife is inserted just in front of the collarbone and is drawn straight back along the backbone on each side



Hockings next grabs his chicken by the neck and pulls; out come neck, backbone, and all the entrails, completing the cleaning process





The carcass is torn in pieces—two of them, to be exact; the breastbone is removed by a few deft motions—see Hockings for particulars—and the sixty seconds are nearly up

Forty-nine bottles hanging on the wall are nothing when compared with the hundreds of pitchers hanging on these walls

Pitchers, Pitchers Everywhere

THIS is Mrs. James Hensley of Knoxville, Tenn., and she owns two thousand pitchers! She loves them and collects them.

One of them, low, squatty, and black, was made by the Aztecs in Mexico back in the fourteen hundreds. Another is a clown and near it is a little red devil whose tail serves as a handle. A copper pitcher from Algiers looks in heathen wonder at a sombre gray pitcher made by Anton Lang, the Christ of Oberammergau.

In one room corn pitchers are predominant. But there are also watermelon and pumpkin pitchers. Another room has been turned into a pasture where cow pitchers graze on the floor.

A One Mule Power Automobile

JOHN A. F. DE LION left Philadelphia for San Francisco in a pushmobile with a mule hitched behind to do the pushing. And, stranger than this strange fact, he got there. His mule pushed him all the way.

This proves conclusively that Mr. de Lion was not a freak or fool, but a very wise man who knew his own mule. This one lacked the dominant characteristic of his kind, balkiness, and therefore made excellent motor power.

Since the mule took the place of an automobile engine, he was awarded a New York auto license. We have heard of engines being balky, but should they be indelicately classed with mules?

The automobile and the engine. We know gasoline is dear but really there is a limit!

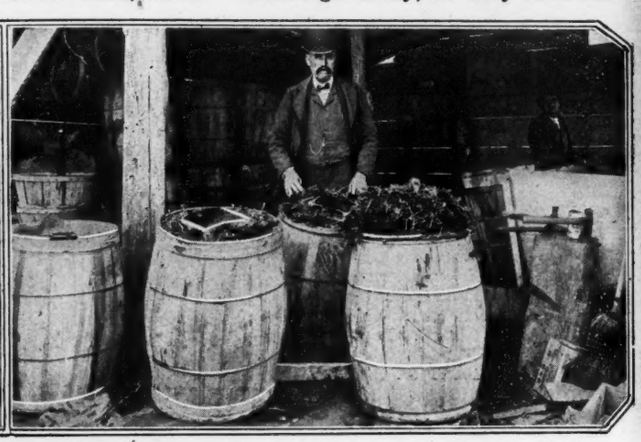
How This Little Soup-Green Went to Market

WHEN you order steak you usually find a spray of parsley trimming the corner of your platter. It is fresh and green—looks as if it had been picked in the garden of the restaurant just for you. Most likely it grew on a farm many miles away and had left home long since. How does it stay so fresh? It is very carefully packed in sugar barrels when it is shipped. A large piece of ice is tucked in each barrel and then the barrel is covered with burlap. In this cool, dark, damp condition the parsley does not dry up. The sun that makes things grow will ruin them after they are picked, so they must be well protected.

Take the case of the cantaloupe. It is picked when mellow and then rushed to the shade of a cantaloupe house for packing. The house is but a rudely built, brush-roofed shed, which is torn down when the packing season is over. But the melons would have reached market over-ripe had the packers "let a little sunshine in."

In fact most tropical fruits which are shipped to us are sent unripe. They finish the ripening process on the way—that is why they don't taste so sweet when we get them as they do when picked right off the tree and eaten right away, for they need sun.

Cantaloupes must be packed in the shade to keep them from getting over-ripe, so temporary sheds are built



Parsley is carefully packed in sugar barrels. Each barrel contains a cake of ice and is covered with burlap

Making the Tides Work for Us

When the world's coal supply is finally exhausted we may turn to the tide motors which commerce now scorns

By Joseph Brinker

HARNESSING the heat of the sun and the power of the tides and making them do useful mechanical work for mankind have always been two great dreams of inventors. Perley Hale, of San Diego, California, has invented the method for taming the tides shown in the accompanying illustration.

Trapping the Tide

Two series of reservoirs are located one above the other between high- and low-water marks. Each of these is open on the sea side by means of automatic gates working by gravity, so that on the rising tide water is trapped in the upper reservoir. If this reservoir is of sufficient volume, enough water can be stored in it to operate a water turbine in the bottom. The water passes through the turbine and down into the lower or waste reservoir, where it is retained until the tide has fallen sufficiently to allow it to drain off into the surface of the ocean.

The working of such a tide-water plant may be compared to that of a reciprocating engine having a gigantic piston which moves up and down twice a day (once for each tide). Mr. Hale's plant is very different in nature from the motors which are driven by the intermittent action of the waves and are much more complicated machines.

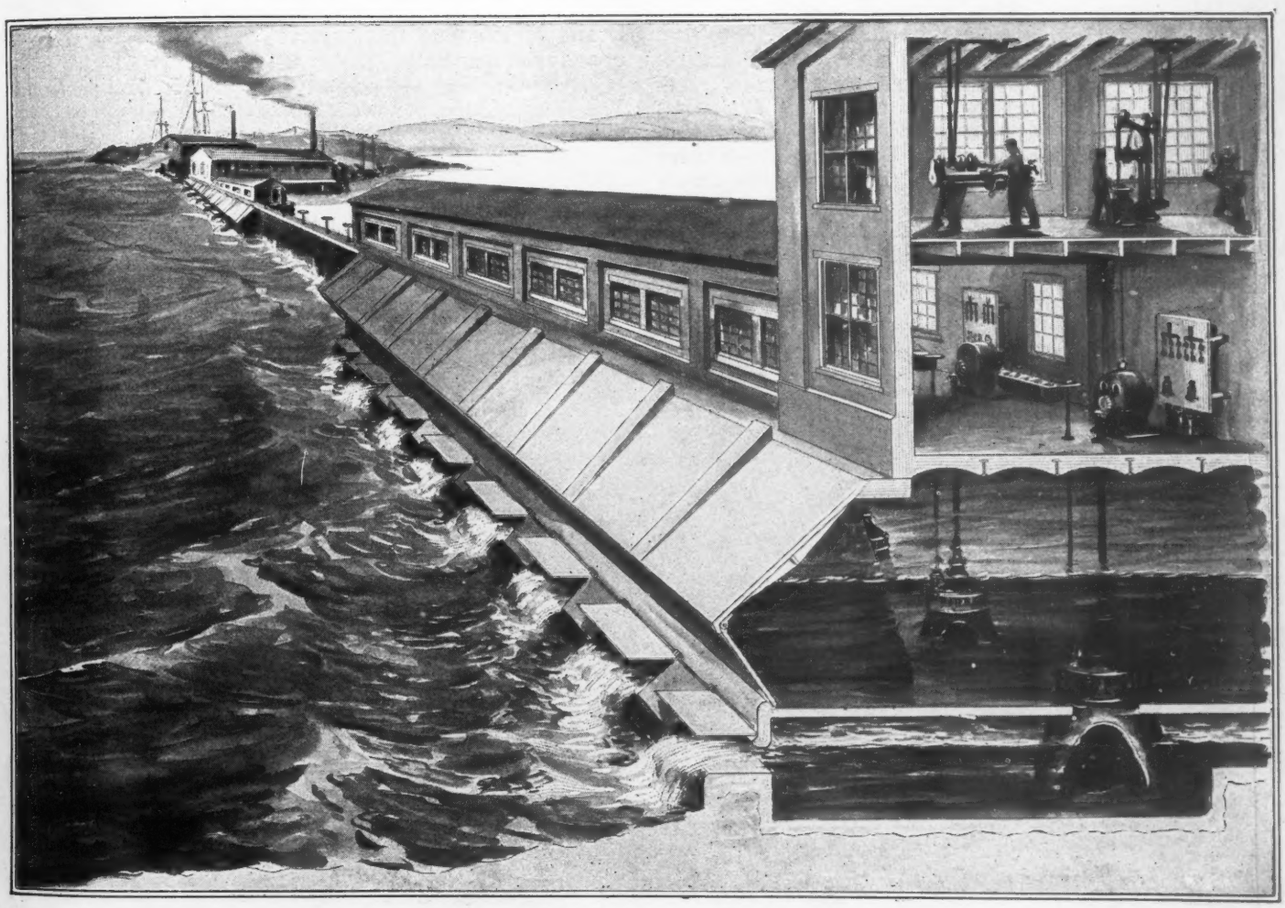
The rapidly rotating turbine, mounted on a vertical shaft, could be made to drive a generator to provide current which could be used in manufactories built on top of the reservoirs or transmitted inland by wires for other power purposes.

While a tide-water plant like that shown might be located at any point along a coast, more power could be secured if it were situated where the rise of tide is abnormal—as in the Bay of Fundy, where the rise and fall is seventy feet. The head of water in the top reservoir above the turbine would then be greatest and similarly the power developed from that head.

While both the harnessing of the heat of the sun and the power of the tide are feasible, engineers condemn both enterprises as commercially impracticable. It is the tremendous cost of the construction of the reservoirs and the small power output due to the low head of water, except in extreme cases, which make the cost of tide power so great.

Tide Power is Far Off

Some day, when all the available river dam sites are utilized, when the supply of coal is as short as that of gasoline today, and when the heavy fuel oils have been exhausted or reserved for the navies of the world, if there are any at that time, then perhaps the tide motor will succeed.



The water which flows into the upper reservoir during high tide is allowed, when the tide recedes, to flow through a turbine wheel into the lower basin and thence into the sea. The power may be used for any desired purpose

Are the Panama Locks Too Narrow?

IT looks very much as if the two English officers shown in the picture to the right were going to dance a "Highland fling" on the "blister" of their ship.

What is the blister? Light steel air-tight pontoons which are built along the under-water sides of a ship to protect her from submarines. They project eight feet from the side of the ship.

It is now known that Great Britain blistered many of her cruisers and monitors during the war, among them the *Erebus* and the *Terror*. These two ships were out alone when they were attacked by several submarines. Their blistering saved them and they were able to limp home.

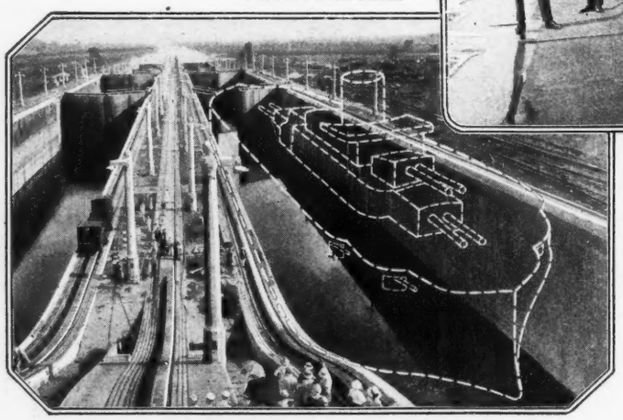
In a number of other cases the pontoons proved equally successful, and the loss of speed through their use was very small—about half a knot. Because of these results it is probable that in the future blistering will be applied to all battleships.

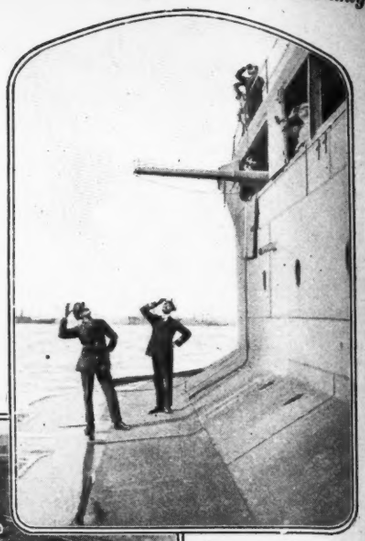
That causes the Navy Department of the United States to ponder.

The locks of the Panama Canal are 110 feet wide; the beam of our latest dreadnought, 97 feet wide; and the plans for future dreadnoughts call for a beam of more than 100 feet. Add 16 feet of pontoon—eight on a side—to these ships and they will be wider than the locks!

If our ships are "blistered" how shall we travel from coast to coast? Shall we change the width of the locks, of the ships, or of the pontoons? Or will it come to sending our largest ships around Cape Horn, as of old?

Publishers Photo Service





International Film Service

Air-tight steel pontoons along the sides of a ship protect her from submarine attack

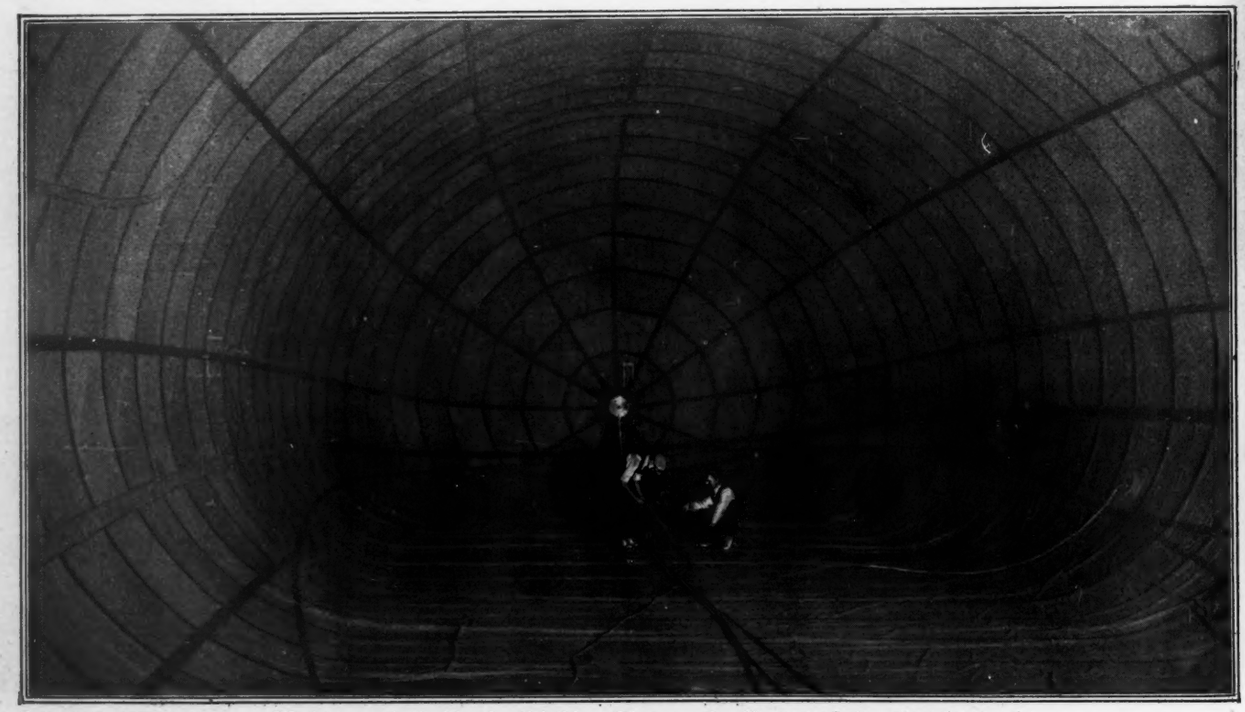
If we add sixteen feet to our dreadnoughts they'll be wider than the Panama Canal locks

In the Belly of a Dirigible

THE end of a tunnel? No; the end of a dirigible as seen from the inside. The shining spot in the distance is the mouth through which the dirigible breathes.

The huge bag is filled with hydrogen gas. As it rises in the air the pressure decreases and the gas tries to expand. But this would stretch the casing. So the mouth—a valve invented by a man named Gammeter—opens automatically and exhales until the pressure within is normal, whereupon it shuts again.

When the dirigible comes down the reverse is true. The pressure increases without and the bag tends to cave in. Balloonets—small balloons inside the dirigible—are used to keep the pressure constant on the way down. As the hydrogen contracts the balloonets are expanded.



© B. F. Goodrich Rubber Co.

Working on the inside of a dirigible. Of course they'll get out before she takes to air

Flying without Wings Has Its Thrills

Riding a bucking orientator provides most of the sensations known to the aviator

By Loren Palmer

IT was the first time that he had been alone at the controls of the airplane. John Harvey had the theory of the thing down pat, but how would theory and practice hitch up?—that was what he was asking himself as the instructor saw that the safety belt was properly secured and gave the order to go. A moment later John Harvey was concentrating so fiercely on the business in hand that all else was forgotten.

"Steady, old man," he said to himself as he found that he was gripping the control-stick so tightly that his fingers ached, and he pushed the stick gently forward.

The machine dipped its nose gracefully. Harvey promptly reversed the motion of the control until he was again on an even keel, and pushing with his right foot on the rudder bar he swung around to the right. Suddenly he remembered that he wasn't banking. He pushed the "joy-stick" over and the machine tipped sharply to one side—too sharply, and Harvey wrenched at the stick to avoid whirling completely over.

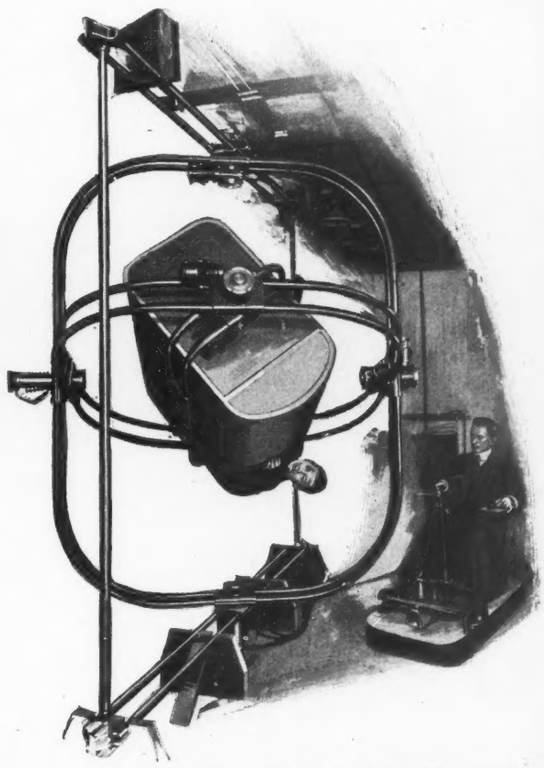
Then things began to happen. Jolted forward by the quick motion, Harvey unconsciously pushed against the control. Instantly, it seemed to him, the machine went into a nose dive. He tried to reverse, but too late. The machine was making an impossible reverse loop and Harvey's senses were whirling with it. But he didn't crash. Something held him suspended.

"If I can't get out of this one way, I can another," he muttered, and pushed the stick far to the left. At once the car whirled over and Harvey's ear canals—those keen centers of equilibrium within the inner ear—told him that he was right side up once more.

Rough Going

Harvey was digesting his new sensations when the machine began to rock and pitch violently. Tug as he would at the controls, Harvey could not keep on an even keel. An imp of perversity was in the thing. If he pushed the stick forward the machine seemed determined to go somersaulting eternally through space, and when he tried to bank, the blamed thing seemed to interpret it as an order to roll completely over. But little by little Harvey got the knack of the controls and presently he was master of the situation.

Dangerous, not to say impossible stunts for a beginner? Not at all. John Harvey was as safe as you are sitting in your chair reading this. He had performed most of the evolutions possible in a modern airplane—and some impossible ones—without ever losing touch with the solid earth.



Photograph by Division of Aeronautics, U. S. Army

Whirled about in this machine the student-aviator develops the "ear-motion sense" so vital to the flyer

The explanation is the Ruggles orientator, a machine resembling somewhat a giant gyroscopic top, equipped with a section of airplane fuselage, or body, and controlled in its movements exactly as is an airplane. It is used to train the student-flyer in orientation and motion-sensing, and to accustom him to all the sensations of aerial spins.

Such training means the difference between life and death. Maj.-Gen. George W. Squier said recently that 90 per cent of the flying casualties during the war were caused not by bullets, or badly built machines, but by "the failure of the man." In 1912 William G. Ruggles invented a machine that would whirl the novice and enable the flight surgeons to test his reactions. But the need was for a way to teach aerial stunts and airplane control without danger; so Mr. Ruggles improved his invention. He provided two sets of large steel rings, large enough to carry part of an airplane body, swung one within vertical and one within horizontal bearings and driven by small motors so that the rings revolve one within the other. The longitudinal axis of an airplane body, suspended by bearings on the inner ring, is also revolved by the motors. Adding controls, like those of an airplane, to enable the student to regulate the motion in any of three directions, both forward and reverse, the inventor had a machine in which the beginner could practice all the motions of flying and try all the tricks except leaving the ground and landing. Mr. Ruggles also provided a dual control on the floor by means of which an instructor can control the movements of the car.

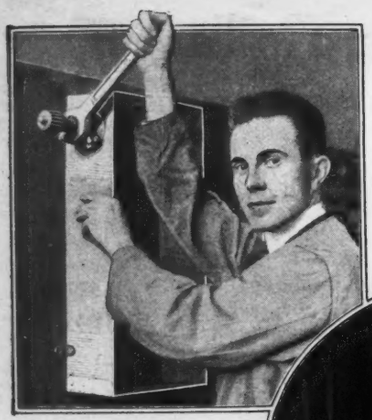
Fighting for Control

It was the manipulation of the floor control by his instructor that caused John Harvey to think that the thing was bewitched when taking his first lesson. If the instructor's action is not met and promptly countered by the pupil the instructor can send him spinning over and over, or around and around in a circle in either direction, or rolling sideways. But the mastery is always in the hands of the man in the car, provided he is skillful enough.

When the instructor pushes his control-stick forward the car in the orientator begins to fall, or, more accurately, to turn with its nose down just as an airplane would start in a nose dive. The motion can be overcome by the student bringing his control-stick slightly toward him. If the student fails to meet the instructor's move the car will spin on its lateral axis, performing a reverse loop impossible in an airplane. The other movements are started and controlled by the instructor or pupil moving the control-stick or the rudder bar exactly as in a flying airplane.

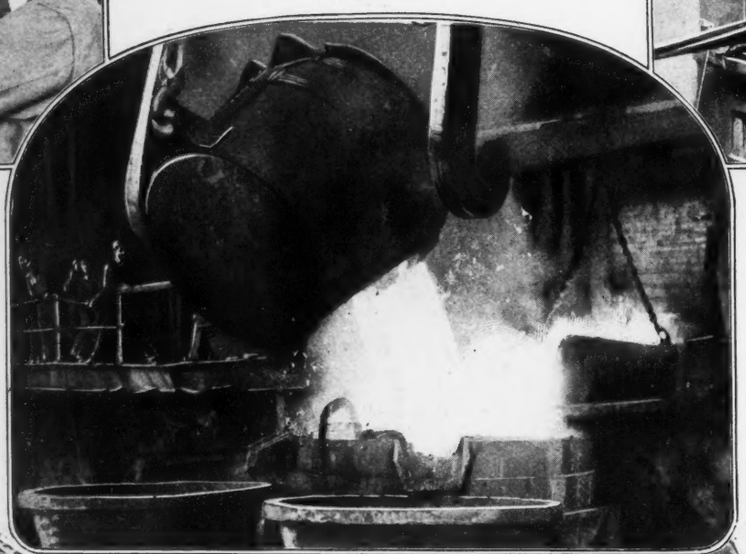
Practice on the orientator develops "ear-motion sense," which will serve a pilot when muscle sense and eyesight fail to do so.

Do That Hard Work with Tools and Machinery

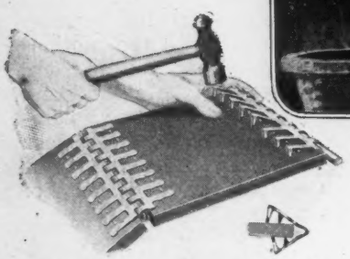


With many advantages over the cold chisel, this tool makes a clean round hole in metal, slate, asbestos, linoleum, automobile bodies, boilers, tanks, etc. It can be operated from any position

The eight holes in the hub are drilled by a jig which fits over its outside diameter. The airplane propeller is made from spruce of the best grades, and it is drilled in the short space of three minutes

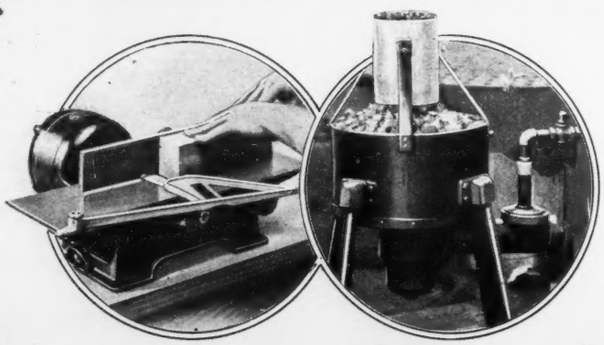


Weighing the iron as it runs into the ladle, the operator reverses his controller and brings the mixer back into position, automatically shutting off the flow of metal



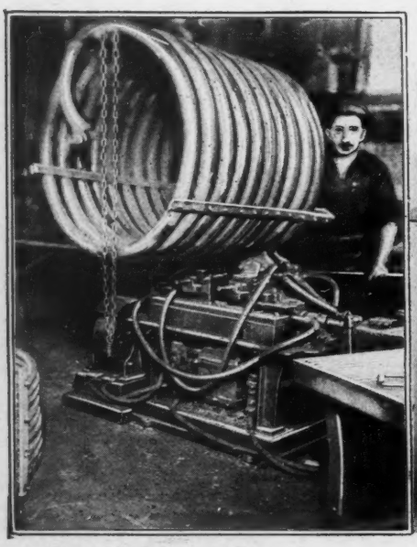
This belt-fastener with teeth like those of an alligator has great tensile strength; it grips the long fibers of fabric belting and is smooth on both sides

When the guide hooks are set over the wire joint the wireman presses a bulb and the connection is soldered neatly. No solder is wasted

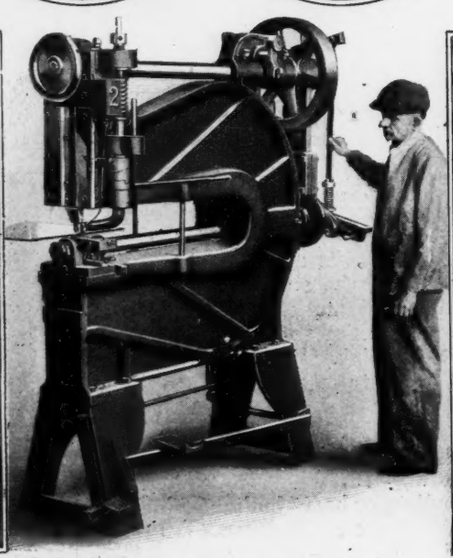


At the right is a portable bench-plane run by a small electric motor. An automatic safety guard prevents the operator's injury

Cleaned but once in twenty-four hours, it not only saves compressed air and heats more rivets, but heats them with uniformity



When the pipe is welded the coiling-machine forms its length into a coil. Then back it goes for another section to be welded on



This machine makes the cutting and handling of odd shapes, inside cuts, and plain cutting a quick and inexpensive operation

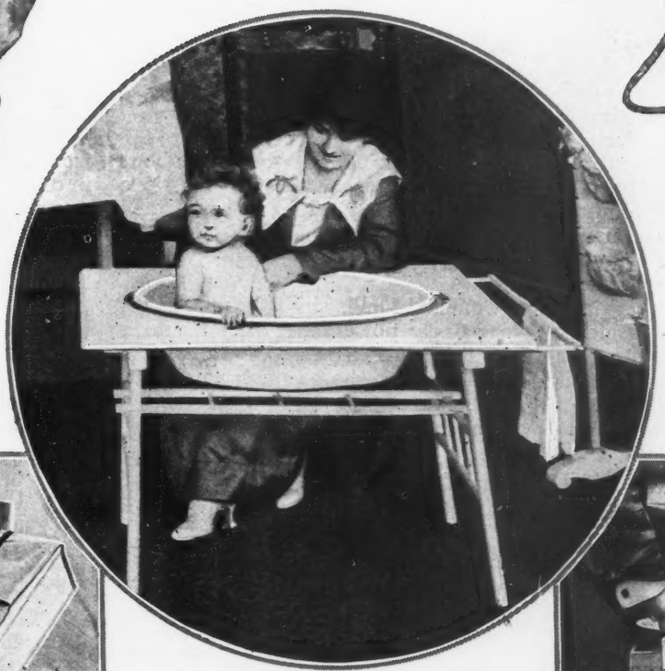
A handful of letters set under the machine is tied in the space of five seconds, thereby eliminating hand tying and extra help

Housekeeping Made Easy

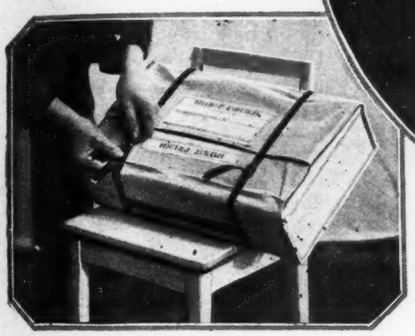
Some devices that will save energy in the home

No more aching arms are necessary to get your packages home. A curved piece of metal fits over two fingers, and strings from as many as twelve packages may be slipped into it

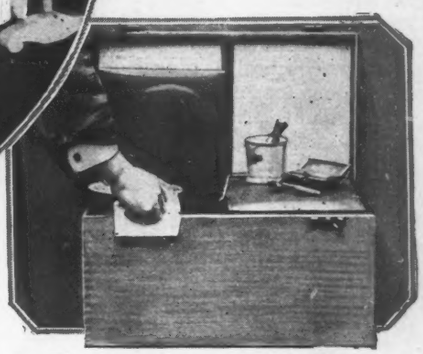
Particularly adapted for desk use or the bridge table is an electric fan which carries its own battery. The blade arrangement prevents the blowing away of whatever is beneath its wind current



Just high enough to enable mother to give baby her bath. Tub and stand are of white enameled wood. At one end is a convenient towel-rack. Dressing is made easy by placing a sewing-table across the top



Bundle your soiled clothing into a parcel-post package, and, lo and behold, your laundry worries are over



Keep your shaving water hot overnight in the fireless cooker while camping or on an automobile tour. Try it and get a smooth shave

An attractive, simple way of making coffee on the dining-room table is accomplished with this glass percolator; the coffee does not touch metal

A set of containers to hold cookies, etc., in a store. Push a lever and the glass jar tilts, at the same time lifting its cover automatically

When baby's bed is not in use, it is quickly folded and slipped between the spring and the frame of the bed to which it is attached

Making a New Fuel to Order

How colloidal fuel helps oil and coal to do more work

By Walter Bannard

THE mightiest war-ships burn under their boilers not coal but oil. In 1917 and 1918 it was so difficult to obtain oil that for a time it seemed as if the battleship fleets of England, France, and Italy would be unable to perform their task of bottling up Germany and Austria. The situation was alarming. The submarine was literally turning off the spigot of Europe's oil supply.

In this emergency the engineering committee of the Submarine Defense Association of New York, of which committee Mr. Lindon W. Bates is chairman, determined to begin a series of investigations to meet naval demands. An oil expert of international renown, he decided that a composite of oil and finely powdered coal would meet the demand.

It was not a new idea; but it had come to naught because the heavy coal particles always settled in the oil. Some way had to be found of holding the minute coal particles in suspension for a number of months. When the problem was solved "colloidal fuel" was created.

Particles that Always Dance

What is a colloid? Chemical history answers. Between 1861 and 1864 Thomas Graham discovered that, when certain dissolved substances are separated from a surrounding solvent by a membrane of parchment or fish-bladder, some of them pass through the membrane freely into the surrounding solvent, while others remain behind, only to diffuse very slowly. The particles that do not pass through are evidently larger than the pores of the membrane. Graham called them "colloids."

Victor Henri, a French scientist who has done much to explain colloids, says: "There are no colloids; there is only a colloidal state, just as there is a solid state and a liquid state." When you blow a puff of cigarette smoke from your mouth you see a gaseous colloid of carbon. The finest ruby-glass is a solid colloid of gold. In a colloid there is no chemical union or combination between the particles held and the medium that holds them. A current of electricity passed through a colloid drags the particles with it.

These particles are always in a state of violent agitation, dancing about irregularly because of the collisions that incessantly take place.

Preventing the Powder from Settling

Colloidal fuel is simply a mixture of very finely powdered coal, oil, and a stabilizer ("fixateur," Mr. Bates calls it) to prevent the coal particles from settling in the oil.

The nature of the fixateur is not disclosed. It produces a state in which the force of gravity is so far overcome that the mixture of coal and oil remain permanent for months. When settling does eventually manifest itself, brief stirring is all that is required to restore the fuel to its previous consistency.

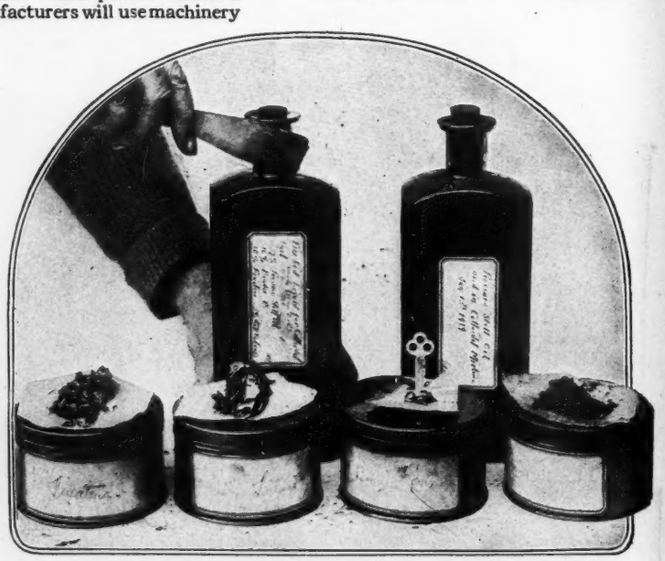
It is possible to sustain for months from thirty to forty per cent of coal in oil. In a colloidal fuel about forty-five per cent oil, twenty per cent tar, and thirty-five per cent pulverized coal can be combined, thus displacing more than half of the oil and securing equal or greater heat values for each barrel, thereby saving much money. At least twenty-five per cent of the fuel oil now burned is conserved and the world's supply of liquid fuel is increased by fifty per cent.

Oil refiners have always wondered how they could dispose of their residues profitably. Colloidal fuel supplies the answer. The "Cinderella products of refining," as Mr. Bates calls them, can be used to prepare a fuel that will command a premium because it is valuable in making the higher grade alloy steels.

The "fixateur" is the magic substance that prevents the finely powdered coal from settling in the oil. You can compound colloidal fuel to suit your requirements. This picture shows a drug-store way; manufacturers will use machinery

It Can Be Pumped Like Oil

Colloidal fuel can be compounded like a prescription. This means that the particular kind of fuel best suited for a particular plant can be made by a central laboratory. One composite in the range of ordinary temperatures is composed of



In the first can is the "fixateur." The second contains wax tailings—a residual waste which has always bothered the oil refiner. In the third can is a binder; in the fourth "anthracite rice." The bottles contain liquid colloidal fuel and pressure still oil used in colloidal mixture

about half coal and half oil. Another unctuous semi-liquid is nearly three fourths coal and one fourth oil. The more coal that is added the more paste-like the fuel becomes. But all the pastes are mobile up to sixty per cent coal, and are pumped and atomized as if they were liquid. With the liquid grades the oil-burning equipment of a vessel or a plant need not be changed.

At sea astonishing results have been secured. The net saving of oil on the research vessel with which the Submarine Defense Association experimented amounted to twenty-seven per cent. Moreover, with the same tank or bunker space a longer cruising radius without refueling is obtained. A war-ship or a merchant-ship can increase its steaming radius up to twenty-five per cent.

Cost Savings

The savings of cost involved in the use of colloidal fuel are remarkable. An industrial company in Ohio burns three hundred bushels of oil per day; its oil costs seven cents a gallon; its coal five dollars a ton. A saving of fifty-five cents a barrel, or one hundred and sixty-five dollars a day, is effected by the use of colloidal fuel, quite apart from considering the conservation of oil and the reduction of transport.

Oil is now extensively used in furnaces of various kinds—brick-kilns, annealing plants, blacksmith shops, brass foundries, and steel works. About seventy per cent of the oil burned by these furnaces can be made to do the present duty of one hundred per cent, and more cheaply at that.

Coal that is useless for ordinary industrial purposes is powdered and mixed with oil to make colloidal fuel. Thus oil is made to go farther and our fuel resources are conserved

A certain steel plant uses three thousand barrels of oil daily, and soon it will require four thousand five hundred barrels. But the three thousand barrels of oil with coal incorporated and used as colloidal fuel will be ample for the full output, thus effecting a saving of about five hundred thousand barrels a year.

In industrial plants many millions of barrels of oil are consumed annually. If only twenty-five per cent of this oil were displaced by fluidized coal great savings would result. Three million barrels of oil employed in colloidal fuel could do the work of over four million straight barrels. The oil reservoirs of the world are being drained to their very dregs. We must conserve oil, but not at the expense of industry.

Using Low-Grade Coal

Colloidal fuel opens the doors wide to let the world have from the stills all the assistance it needs without starving hungry boilers or flaming furnaces of the grosser fluid fuels which constitute their food. Moreover, great deposits of low-grade coal, as well as large quantities of lignites, brown coals, and waste dusts, are added to the world's fuel supplies.

The world is familiar with three kinds of fuel—solid (coal), liquid (oil), and gas. We now have a fourth fuel which promises to become of world-wide importance.

Farming without the Aid of Laborers

HOW large a farm can one able-bodied man, unassisted, plow, cultivate, plant, and harvest with a fair degree of efficiency?

Not so very long ago it would have been considered extremely presumptuous for any unaided man to undertake the cultivation of a farm of more than a few acres. Now, however, thanks to the formidable array of labor-saving machines invented and placed on the market in recent years, it is by no means beyond the range of possibility for an enterprising worker to cultivate from twenty to a hundred acres, according to the kinds of crops he expects to raise.

The power-driven cultivator shown in the accompanying illustration is one of the recent additions to the labor-saving agricultural machines that have completely revolutionized farming.

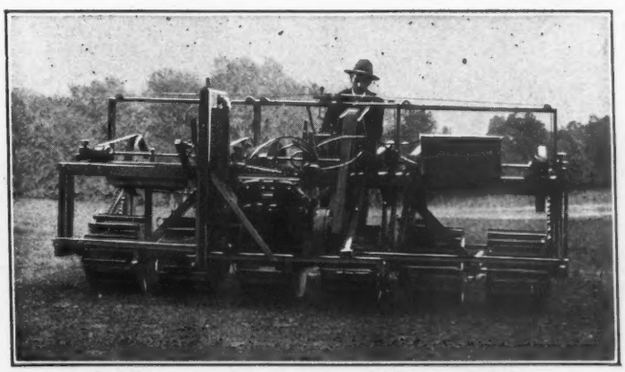
The machine, which is shown in the picture in the capacity of a cultivator, may also be used for drilling, planting, and sowing—special attachments quickly adapting it for the particular work that is to be done by it.

This machine is equipped with six rollers for breaking up the clods after plowing. By adding one or more rollers the capacity of the machine may be materially increased. It can also be used for planting three or more rows at a time. With a different attachment the machine can be used for sowing oats or grass, and by still another attachment it may be adapted for drilling the ground or row-planting.

The drive wheels of this versatile agricultural machine are also its steering wheels. The power is supplied by a gasoline engine, and one man can run it easily.

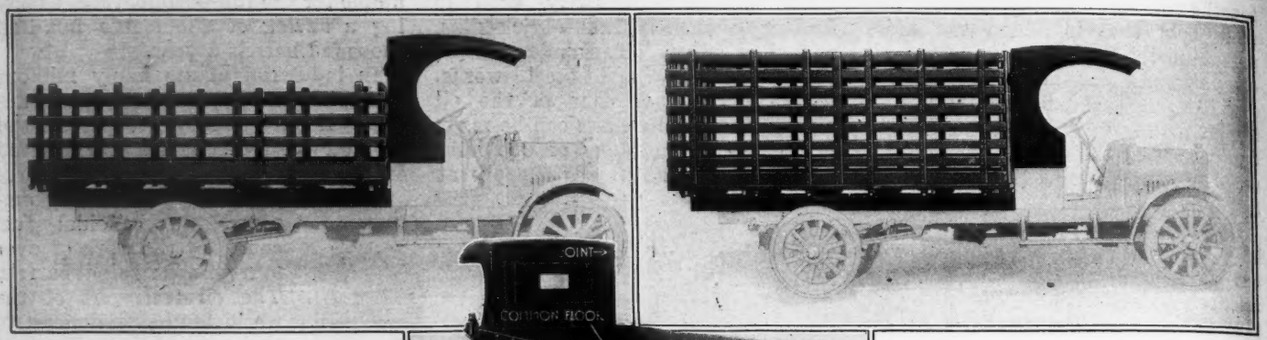
The construction of the machine is simple and substantial. To make the changes for adapting it to the different kinds of work which it is capable of performing takes but little time and does not require the services of an expert machinist.

With a machine of this kind in his possession, the farmer is truly independent of the labor market.

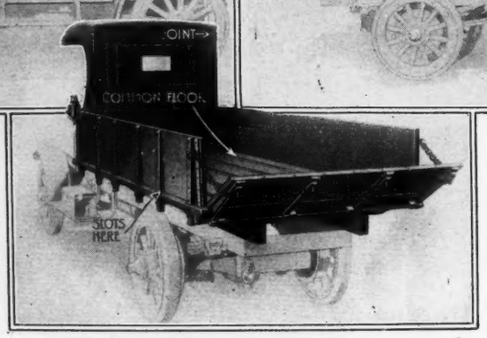


This machine, run by one man, will cultivate, plant, or sow a fair-sized field in a few hours, and, it is said, will do the work better than it could be done by a half dozen men using implements of a more primitive type

A New Universal Multi-Service Motor-Truck Body



Different forms of sides go to build up these universal bodies for trucks; they are designed for various uses



The usual type of truck body can be set in place in a very few minutes

For carrying large loads of boxes, barrels, and the like, this body is excellent; it is easily taken down

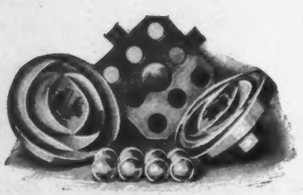
AN Indianapolis motor-truck body-maker has brought out a universal type of body to fit trucks of from one to two and one half tons capacity, provided the frame length back of the driver's seat does not exceed 130 inches. He has gone a step further and provided a means to supply several types. The body is made applicable to all chassis up to two and one half tons capacity by means of adjustable longitudinal sills. Each body has the same platform, with different forms of sides to give it a small or large volumetric capacity. It is this common floor and adjustability of mounting which differentiates this new design of body from the eight-in-one convertible type with fold-up slat sides previously described in POPULAR SCIENCE MONTHLY.

The body may be used as a plain platform with no sides whatever, or it may be furnished with low solid sides, low slat sides, or high slat or stake sides, depending upon the kind of goods the truck purchaser desires to carry. Each side unit is provided with lugs along the bottom edges which fit into slots cut at corresponding distances in the base platform.

Several of the different types, all mounted on the same platform, are shown in the accompanying views.

Cabs for the driver are also furnished for the various types. In each case, however, the cab is a separate unit. Both cabs and bodies are shipped knocked down, so that they may be shipped for much less freight charges than the set-up type of body.

As Sure-Footed as a Mountain Goat



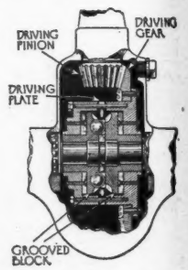
Not many parts to get out of order, are there? And it's as simple as it looks

AS you look at the photograph below you will say to yourself, "Impossible." But what you see isn't a test at all—it's only a part of the day's work; for this kind of a differential, attached to your truck or car, turns it into a veritable tractor. This is, figuratively, what the differential accomplishes by a uniform pull on both driving wheels, operating on a new and simple principle. It does everything that the complicated differential of the conventional type does, so the makers claim, and in addition provides a retardation or locking action which prevents spinning and skidding.

Only four plates compose this differential—a driving plate, two grooved blocks, and eight steel balls through which the power is transmitted. When the car or truck is running in a straightaway, all these parts revolve as a unit. When the wheels are revolving at different speeds, the position of the cam-blocks changes by reverse movements in relation to the driving plate and balls.

Those of you (and who hasn't?) who have been stuck in a mud-hole will immediately realize the value of such an accessory, for it does away with that expensive span of mules that are so necessary to a stalled motor vehicle.

For the truckman or store delivery this type of body is a decided advantage, since it permits carrying any kind of load.



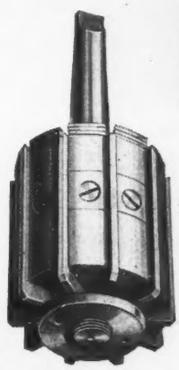
The detailed plan above shows the simple construction of the differential

Pulling out under its own power is a feat not often accomplished by a truck of the size shown here

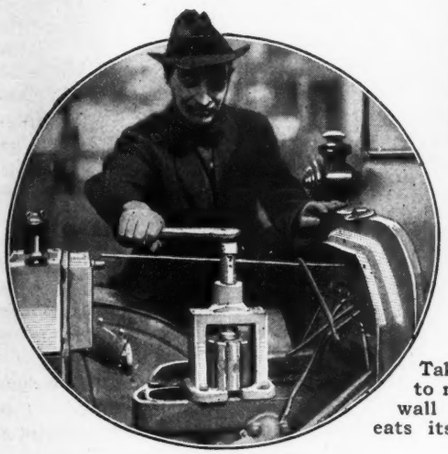
Making Cylinder Reboring Easy

WHEN run for a long time Ford cylinders often get out of round, necessitating reboring—at best, a long and tedious job. A mistake means that an entire new engine block is necessary. Mechanics and Ford-owners will surely welcome a device that eliminates all chance from this operation and speeds up the work.

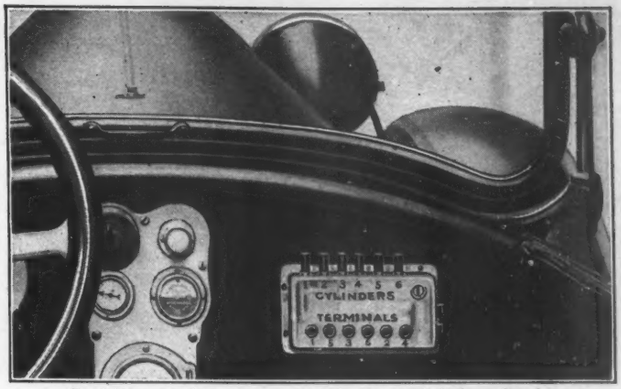
These reamers are set exactly 3.781 in. in diameter, or the exact size to fit the oversize pistons furnished by the Ford Company. The blades are made of the best quality steel, and can be adjusted to larger or small sizes at will. As they are made interchangeable, the blades, the shank, or any other part of the reamer can easily be replaced.



By means of screws the blades are made adjustable to the cylinder to be bored



Taking off just enough to make the cylinder wall true, the device eats its way downward



Ignition troubles are reduced to a minimum by installing this device upon your car's instrument-board

Spark-Plug Trouble? Locate It from the Seat

"AHA, there's something the matter with your engine," said the old-time motorist, anticipating great fun in watching the amateur locate the trouble on his new car.

But the driver simply pushed a switch in an instrument attached to the dash, and instantly a series of sparks appeared at six little windows—No. 3 window being left black.

Thereupon the amateur screwed in another spark-plug, and in two minutes the car was on its way again.

This device is attached to the instrument-board of a four- or six-cylindered car, and is wired in series between the distributor or the magneto and spark-plugs. By pressing all the buttons except one, the current to each cylinder except the one being tested is cut off. If the plug is bad the engine stops immediately on that cylinder.

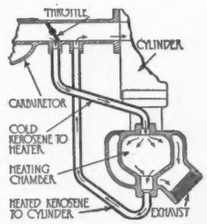
A Farm Tractor Engine that Really Burns Kerosene

THERE have been so many unfounded claims on the part of farm tractor manufacturers that their tractors would burn kerosene successfully that the wise farmer has arrived at the place where he has to be shown before any such claims can become anything more than claims.

With kerosene at its present price as compared with gasoline, it is, of course, advantageous to use kerosene if it can be burned successfully, and provided its use does not seriously affect the engine's lubrication by some of the kerosene passing down the cylinder walls past the pistons into the oil reservoir or result in the speedy deposit of carbon in the engine cylinders as a result of incomplete combustion of some of the fuel particles.

To overcome these difficulties, one of the oldest farm implement and tractor companies has devised what is called a kerosene shunt for the purpose of burning kerosene in the horizontal engine fitted in its line of farm tractors.

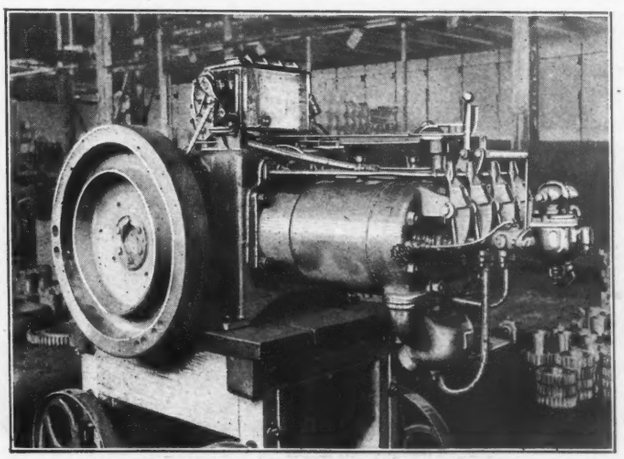
In discussing kerosene carburation, it must be remembered that, while kerosene has a greater number of heat units or will deliver up more heat from a given volume than gasoline, kerosene is more difficult to vaporize than gasoline. Heat is the most active agent to help vaporize kerosene quickly, and heat is employed in the new device when the engine is to be started or run on a light load.



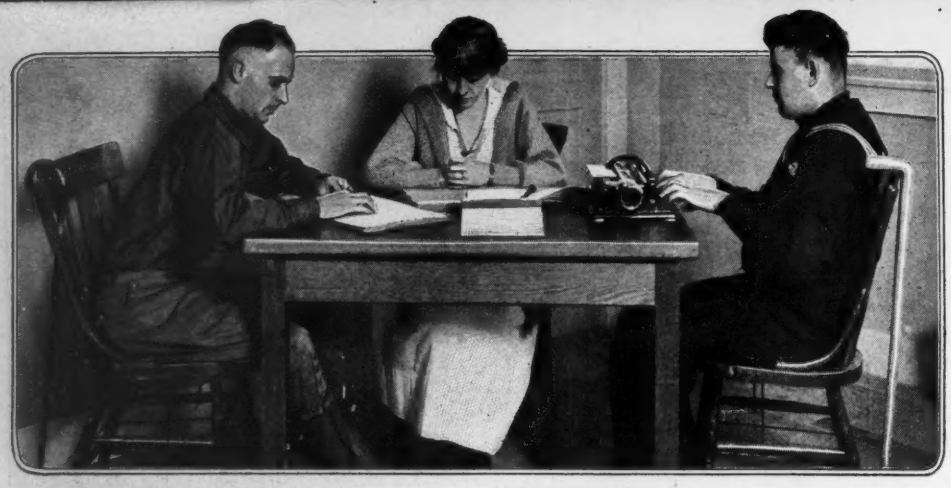
The mixture from the carburetor passes to a chamber heated by exhaust gases

While heat has its advantages in making it possible to start a kerosene engine, it has its disadvantages once the engine is running at its full speed and is put under its full load. Then a heated fuel mixture has not as much power as a cold mixture, since with the cold mixture the expansion of the fuel takes place in the explosion chamber of the engine.

The shunt shown herewith is designed to meet both of these conditions. In starting the engine or while running on a light load, the fuel is heated by setting the throttle valve so that the mixture from the carbureter must pass down a small pipe leading to the top of a small chamber heated by the engine exhaust gases. The heated fuel passes out of the bottom of the chamber and then up a second small pipe that enters the pipe leading from the carburetor to the intake manifold between the throttle valve and the cylinders.



Successfully burning kerosene, this engine does not carbonize or clog its lubricating system



To write one character, the sailor in the picture simultaneously punches six typewriter keys

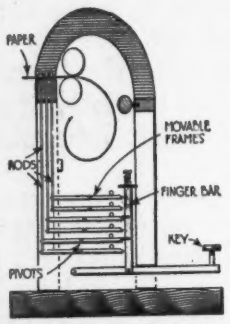
They Write Braille as Well as Read It

ONE hundred and twenty-three Americans, blinded in the war, are stationed at Evergreen Hospital, Baltimore. Are they wondering listlessly how they are going to live? No, they are working hard trying to teach their fingers to read for them. They go regularly to the Red Cross Institute for the Blind and learn to read and write in Braille, the language of raised dots.

Each Braille character is made up of six dots arranged in two vertical rows of three each. Some of the dots are light and others are heavy. The relative positions of the light and heavy dots determine the letter. When a blind man has learned to read them well, then he will be able to write on the usual Braille machine, which has six punches to correspond with the six dots. All six must be punched at once to make a single letter. But suppose the soldier has only one hand, or, even less, one or two fingers? He will not be able to work six punches at once.

Norbert Lallié, a French scientist, has invented another writing-machine which has a regular alphabetical keyboard like that of a typewriter. It can be worked with one finger if necessary, and without any knowledge of the Braille characters. The soldier learns his alphabetical keyboard. When he wishes to write the letter "a," he simply punches a key marked "a." Six rods underneath promptly swing into position and register the six Braille dots of the letter "a" for him.

In the new Braille machine, which works like a typewriter, there are six embossing punches and six movable frames, each of which has a punch attached. There are as many movable finger-bars as there are letters and figures to be printed—just as in the case of an ordinary typewriter. You press a key and it moves the corresponding finger-bar. The finger-bar sets in motion the movable frames to which are attached the embossing punches.



This Braille writing-machine has a regular typewriter keyboard. The operator need not read Braille

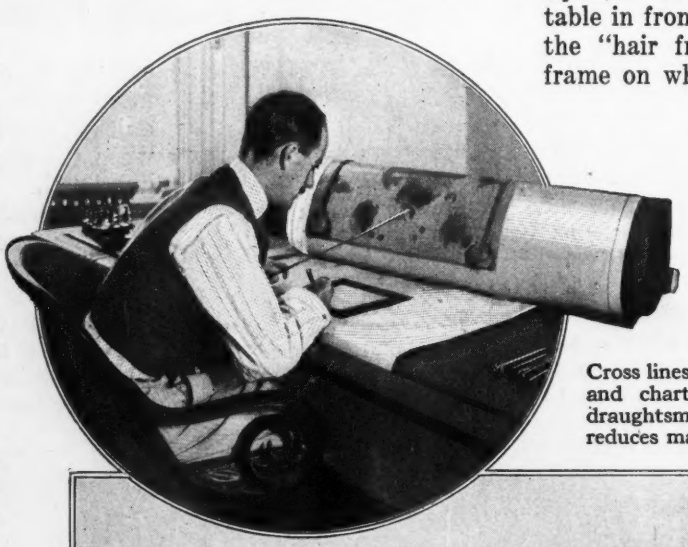
This new machine will lead to much more literature for the blind. For people who have their eyes will be able to write the Braille characters without even knowing how to read them.

How to Make Small Maps from Large Ones

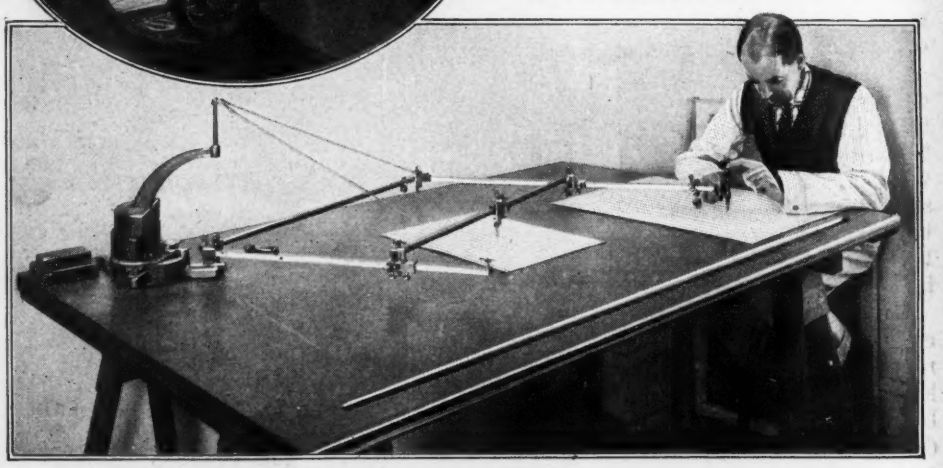
AT any time a sunken derelict may drift into the path of an unsuspecting ship; for the restless sea moves hidden objects about its depths, continually changing the direction of currents. As a result the United States Coast and Geodetic Survey is always out looking for trouble. When they find, for instance, that a sand-bar has disappeared from one place only to reappear in another, they note it on their maps and then make new charts.

The maps are sometimes reduced by photography; but when the reduction is great, or when the original maps contain many unnecessary details, the work is done by hand. In that case the pantograph is often used. In manipulating this instrument the draughtsman moves a pointer over the lines he wishes to reproduce. The pointer is at the end of an extended arm of a jointed parallelogram which is fastened at one corner to a metal stand. A vertical pencil is attached to the center of one side. As the pointer moves, the pencil traces an exact but smaller reproduction of its movement on a sheet of paper beneath it.

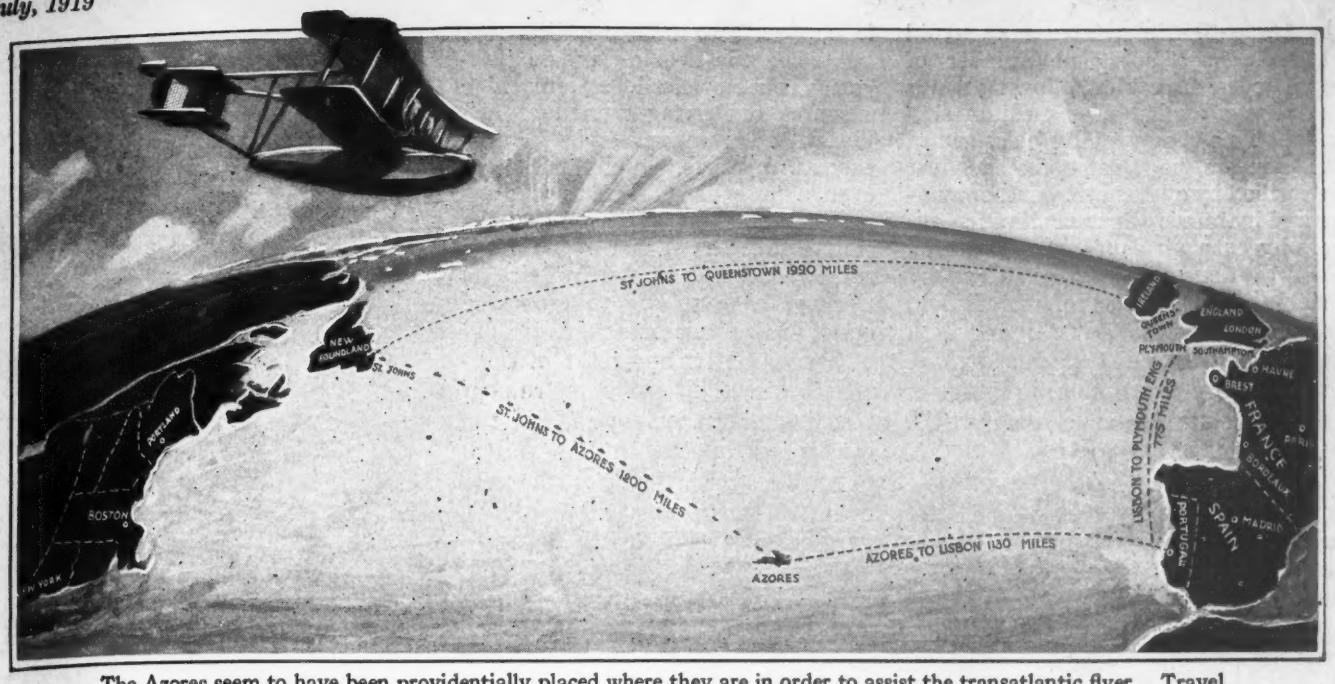
For this work of reduction the Survey also uses a "hair frame." The draughtsman wraps his map around a wooden roll, and places above it a sheet of celluloid marked off in large squares. He puts his chart on the table in front of him and on it places the "hair frame." This is a metal frame on which there are cross hairs placed in exact proportion to the celluloid squares with reference to the scale of the two drawings. The draughtsman corrects his chart by hand, being guided by the cross lines.



Cross lines on the map and chart guide the draughtsman when he reduces maps by hand



In reducing maps by the pantograph, the draughtsman moves a pointer over the original map lines, and a pencil attached vertically to the mechanism traces the lines in reduced facsimile on a sheet of paper



The Azores seem to have been providentially placed where they are in order to assist the transatlantic flyer. Travel to Europe by way of the Azores and it becomes possible to carry a large, paying load of passengers and mail

To Europe in a Flying-Machine

Lessons of the transatlantic experiment and the Popular Science Monthly's ocean monoplane

By Waldemar Kaempffert and Carl Dienstbach

IT is not merely by a poetic fiction that the daring men who vaulted into the air from Newfoundland to cross the Atlantic are likened to Columbus. To be sure, they taught us nothing new about the geography of the world. On the other hand, the ocean air through which they traveled is as uncharted as was the ocean of water in Columbus's time. Meteorologically, it was a real voyage of discovery.

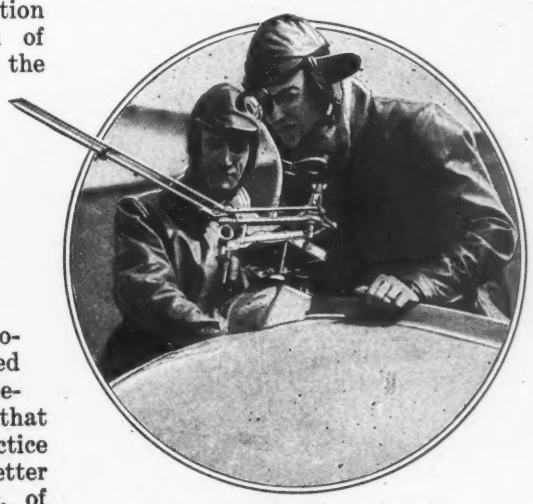
The American Navy has reason to be proud of its transatlantic experiment. It was not imbued with the desire to win a rich sporting prize, but to prove or disprove a proposition scientifically. Hence the chain of destroyers that stretched across the path of flight.

The essence of a scientific experiment is control. Every step must be watched. Nothing must be left to chance or accident.

Use Warships as Observatories

For the first time, regular meteorological stations were established in mid-ocean, among them battleships with a radio range equal to that of most land stations. The practice should be continued. What better use can be made of destroyers, of battleships that must be kept in commission regardless of expense, than to employ them as oceanic weather observatories? Commercial companies, whose enterprise without scientific aid would be as adventurous as that of Hawker, will derive immense benefit from such meteorological work of the Navy; for they will be warned of impending danger.

One great lesson was learned in the great American effort to cross the Atlantic. It is this: The art of flying is in advance of oceanic meteorology. If vessels of the NC type are to be employed for the crossing of the Atlantic—vessels lumbering and slow in comparison with the swift passenger-carrying transatlantic flyer of the future—we must be able to predict the Atlantic weather twenty-four hours in advance.



With this drift-indicator—very like a bomb sight—the true course of the seaplane can be established so long as the surface can be seen

The Air—an Uncharted Ocean

Where are the carefully tabulated observations that make that possible? Beyond a few joint experiments in kite-flying made from the decks of the Prince of Monaco's yacht by Teisserenc de Bort and Professor A. Lawrence Rotch, and by government scientists from the decks of the United States Coast and Geodetic steamer *Seneca*, nothing whatever has been done to explore the Atlantic atmosphere.

Before regular transatlantic flying becomes a reality, the United States and Europe must systematically explore the atmosphere over the ocean, just as the atmosphere over the land has been explored from the ground to a height of about twenty miles.

So competent an authority as the late Professor A. Lawrence Rotch predicted, long before our vastly improved flying-machines appeared, that it would be feasible to cross the Atlantic every day of the year in northern latitudes if the permanent western planetary winds that prevail above ten thousand feet could be used. Unfortunately, support is poor at such a height; to carry much cargo there is out of the question. By skilfully selecting his level, Rotch argued,

the transatlantic aviator may avoid head-winds; a sufficient number of more or less favorable following winds are always available at medium altitude. This theory of Rotch's, one of the pioneers, be it remembered, must be verified by systematic weather studies and by numerous transatlantic voyages by both airplanes and dirigibles.

If the successful trips of many machines vindicate Professor Rotch, commercial transatlantic flying is a matter of but a few years. In the present stage of aviation, it is almost criminal to use land machines over the ocean for passenger service.

We have said that meteorology—transatlantic meteorology—has not kept pace with the demands of aviation. The obstacles offered by fog prove the assertion.

The navigators of the NC flying-boats knew that fog is the aviator's deadliest peril. It may be questioned, however, whether they were quite prepared for the peculiar variety of extensive, obstinate, high-sea fog, combined with a heavy sea, that proved the undoing of two of the planes on the way to the Azores.

It is the old, old story, but is told with a new thrill. The pilot of the NC-4, suddenly deprived of all his subconscious visible indications of horizontal direction, became confused. The semi-circular canals of the middle ear (the spirit level in our heads) tells us whether or not we are on an even keel. Yet, for some curious psychological reason, he could not tell that his vessel was banked—in other words, tilted sidewise so that it tended to run around in a circle.

Wanted—a Substitute for the Human Ear

In a fog a flyer's sense of direction and sense of verticality are so far destroyed that he cannot tell at what angle the machine is banked. He guesses at the angle. The compass is supposed to indicate direction; but when the needle wanders navigation is demoralized. If a machine executes one flying maneuver unbidden and unperceived, it may execute any other equally unbidden, even a nose dive. It was the appearance of the sun through the clouds that saved the NC-4 from running around in narrow circles. Clearly, it is unsafe to cross the ocean in an airplane without the aid of some positive indicator of horizontal direction, some instrument which, unlike the labyrinth of the ear, is not affected by centrifugal force if a mist obscures the sea. Such an instrument is Sperry's gyroscopic level-indicator.

A Great Wireless Station on the Azores

The flight has also taught us the vital importance of maintaining radio communication under all conditions. The commander of the NC-3 had left his ground set ashore. He paid dearly for that. After he had alighted he became dumb, wirelessly speaking. He was able to send messages only in the air with a trailing antenna. Although a half dozen destroyers were near enough to help him, his seaplane was as hard to see on the ocean as a speck of dust on a plate-glass window. Eyes and ears are appallingly limited in range. Only radio communication makes it possible to protect a transatlantic boat flying in distress.

To lay a true course for the small islands in the Azores in mid-ocean is at best a navigation problem of no mean order. But to lay that course through the air in a fog requires all the aid that can be given by modern radio apparatus.

When we consider the mishaps that befell the NC-1, it is evident that without radio apparatus of fair range transatlantic journeys should not be undertaken. So efficient must the radio apparatus be that it can be used for reckoning latitude and longitude even though the machine may be compelled to float for hours, and even days, on the water.

Each seaplane was equipped with flares to light up the sea if a landing at night became necessary

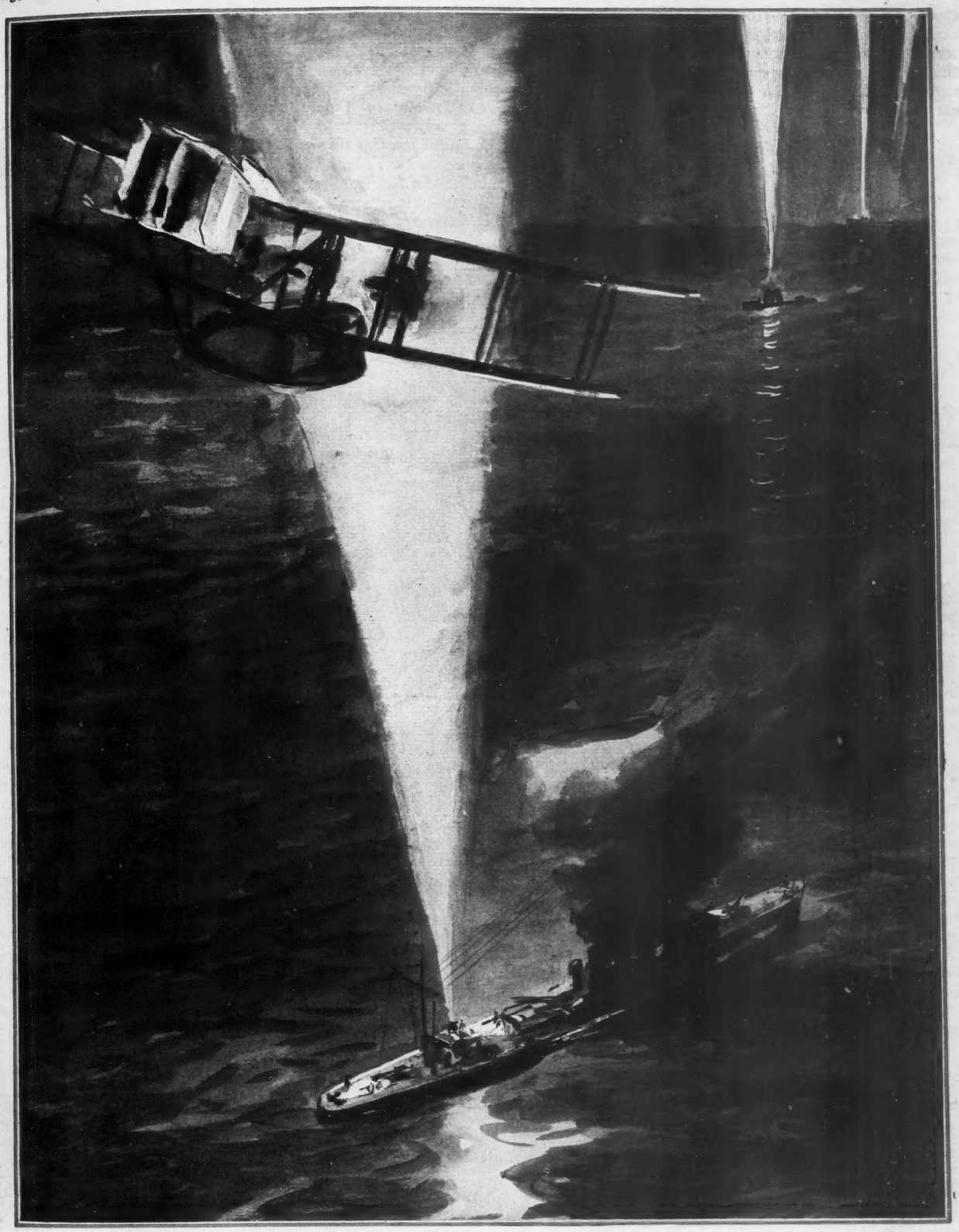
Since the Azores are likely to become of future aeronautical importance, they will surely become the site of a huge radio station, a veritable beacon of electromagnetic waves to guide transatlantic flyers as surely as a moth flies into a flame. At any moment, when that station is completed, the transatlantic aero-navigator may determine his location and then head for the Azores.

It may as well be admitted that, however romantic it may be to cross the Atlantic without a stop, the direct route from Newfoundland to Ireland is of only academic interest for the time being. Aerial commerce in flying-machines will surely move by way of the Azores, simply because it must be prepared to fight head-winds.

Lieutenant-Commander P. N. L. Bellinger, who captained the NC-1, which was compelled to alight in the ocean near Flores, two hundred miles short of its objective. The crew were saved, but the seaplane sank after being buffeted by the seas for many hours

Lightest and smallest of those who manned the seaplanes, Lieutenant-Commander A. C. Read, of the NC-4, brought the "hoodoo ship" through to first honors after misfortunes had nearly prevented his starting. His was the only one to arrive at the Azores on the wing

Commander J. H. Towers, "admiral" of the seaplane squadron. His NC-3, lost in the fog, was forced to drop into the waves. After riding out a heavy gale she reached Ponta Delgada under her own power, but she was so damaged as to be out of the flight



The Guiding Fingers of Light that Pointed the Way at Night

When Kipling wrote his "Night Mail," little did he realize that his idea of using searchlights to guide the nocturnal flyer would be practically applied in the transatlantic flight of the American seaplanes. Each one of the destroyers stationed in the path of flight to guide the argonauts of the air became a visible beacon at night. For miles and miles the long, rigid fingers of searchlights pointed high in the air to guide the men in the planes.

But the searchlights served not only as mile-posts to indicate the course. They were also used to indicate the true direction of the wind. Every scientific precaution was taken to help the men in the air. Since searchlights cannot penetrate a fog, the commanders of the destroyers received instructions to fire star-shells above the fog. Flares with a candle-power of several hundred power each were also to be used in emergencies

Over the shorter non-stop route the machine best adapted to the task would only waste money. Why is this? Because the airplane has to carry fuel in place of money-earning cargo.

What's Wrong with the Machines?

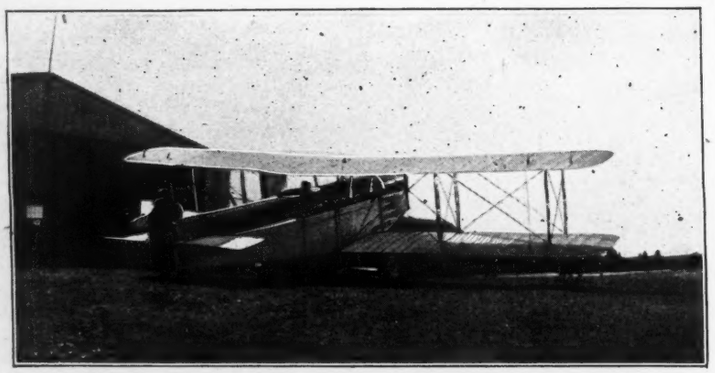
The American seaplanes were not prepared to fight head-winds. They were slow, heavy, cumbersome. Essentially winged sea-boats, they were not streamlined with that scientific care which is so much in evidence in fast fighting planes. In this respect the Sopwith machine of Hawker and the Martinsyde of Raynham were better.

Although the American experiment is scientifically more valuable than the British, there can be no doubt that the transatlantic flyer of the future will more closely resemble the British than the American machines. Not that this transatlantic flyer will necessarily be a land machine, but that it will place its chief reliance on cleanness of line, on engine power, and hence on speed.

The NC planes are merely large copies of the old Curtiss flying-boat. The engines are mounted outside of the hull—an objectionable procedure because of the air resistance encountered. Aeronautical engineers are well aware of this, but they have been forced to continue the practice because the propellers must clear the waves. But the larger the flying-boat, the less reason for continuing the practice. Any one can see for himself how high the propellers of the NC boats were mounted above the water.

The NC type has proved itself decidedly too slow for transatlantic commercial flying. Its speed of sixty to seventy-five miles an hour is not what we expect. It is really a flying cruiser intended to detect submarines, and not a transatlantic flyer.

Not one of the machines that earned transatlantic glory in 1919 was specifically designed for the purpose of flying over the ocean. Hawker's Sopwith machine is a fast bomb-dropper. The Vimy-Vickers and Handley-Page biplanes are likewise bomb-droppers. Six hundred miles is the maximum range for which both the British machines and the American NC planes were designed. Much of the elaborate preparation for the flight can be explained by the provision that had to be made for carrying extraordinary loads of fuel for a voyage far exceeding in length that for which any machine built today is really designed.



When nearly in mid-ocean the single-engined biplane in which Harry Hawker and Lieutenant-Commander Grieve dared the Atlantic flight was brought down by a clogged water-cooling system. Their escape from death was miraculous

The Popular Science Monthly's Transatlantic Monoplane

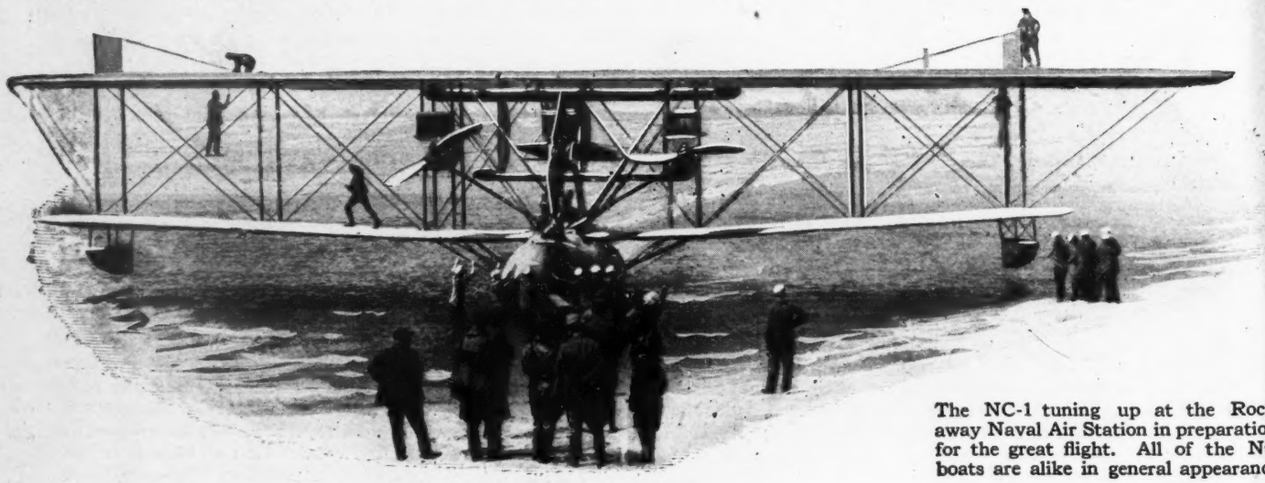
Although the Americans collected more practical information on the subject of transatlantic flying than did the British, it must be confessed that transatlantic flying in the future will duplicate more Hawker's splendid effort so far as speed is concerned. If the business man who must be in London in forty-eight hours is to be deposited in England safely and surely, he must be transported in a machine that will plunge through adverse winds and storms as readily as the *Mauretania* plows through heavy seas.

What will be the aspect of the transatlantic flyer of the future? It must be an evolution of the fast fighting airplane if it is to depend on power and speed. Exactly what form it will take no man may safely predict. This much at least is certain: It will have a completely inclosed body or fuselage; it will have a speed of one hundred and fifty miles, possibly of two hundred miles, an hour.

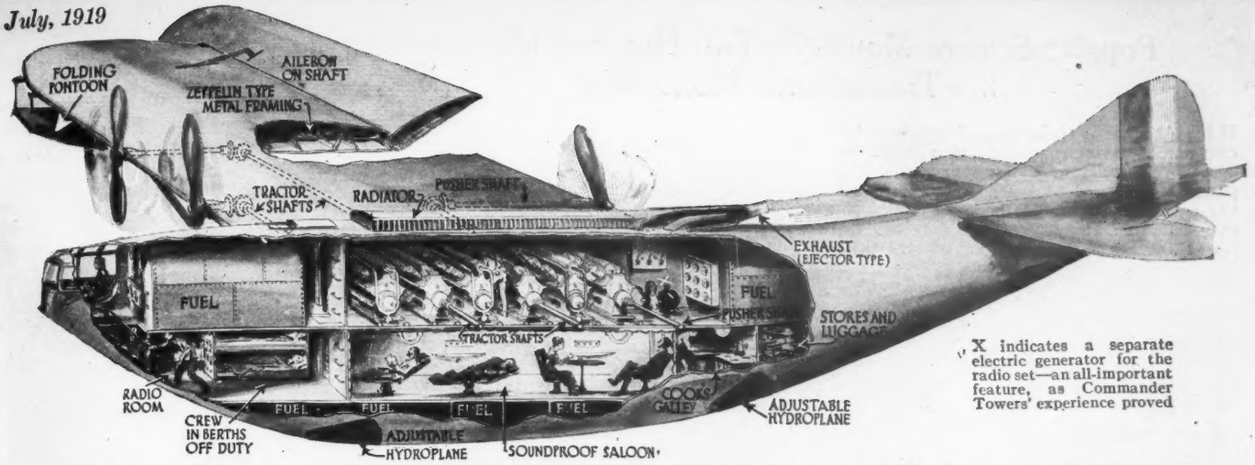
The POPULAR SCIENCE MONTHLY has given this problem some thought. It presents to its readers the plan of Mr. Carl Dienstbach, its aeronautical editor. You will find nothing revolutionary in his plan; it is based on the experience of the last ten years in flying over land and sea.

Since the machine must cross the ocean, it must also carry much fuel; but the carrying of a heavy load and the attainment of high speed are almost incompatible. An enormous lifting surface must be provided to raise the load, and much of this lifting surface is not only useless in the air, but decidedly detrimental because of the air resistance that it offers.

Since there must be the utmost economy of surface and power, Mr. Dienstbach has decided that the machine ought to be a monoplane of about one hundred feet span. Curiously enough, the late Count von Zeppelin, after devoting the last months of his life to the construction of a mammoth seaplane, also arrived



The NC-1 tuning up at the Rockaway Naval Air Station in preparation for the great flight. All of the NC boats are alike in general appearance



X indicates a separate electric generator for the radio set—an all-important feature, as Commander Towers' experience proved

To gain speed the engines and passengers are enclosed in a perfectly streamlined hull. Note that the passengers must sit or recline. There is no room to walk about upright. Weight is precious, so that there cannot be more than three in the crew. Every passenger is weighed before he steps on board. He pays so much per pound for having himself transported

at the conclusion that a monoplane is the correct type—a conclusion of which Mr. Dienstbach was not aware at the time he designed the POPULAR SCIENCE MONTHLY flyer.

Mr. Dienstbach was inspired by the monoplane of Mr. Grover Cleveland Loening, probably the fastest that has thus far been designed and built. The Loening construction lends itself well for the purpose because it is so stanch, because it does away with fuel-wasting projections, and because it consumes little power for the speed attained.

Now, in any transatlantic flyer, speed is dependent primarily on perfect streamlining, which means that every projecting surface must be so designed that the air is parted with the least possible resistance. It was the French designer Nieuport who was the first to attain racing speed in this scientific way.

The narrow high fuselage of the Loening construction is a great advantage because the engines can be placed within the streamlined hull. Because the machine has but a single surface it encounters less resistance in its onward progress than a biplane. At the start of a flight with full load it is practically impossible to vary speed; but toward the end of the voyage the speed becomes more adjustable as fuel is consumed. Moreover, the flying angle can be reduced from that of the utmost efficiency for lifting to a flatter angle, which means still higher speed.

The mechanical advantage of having the engine inside the hull is obvious enough. But will not the passengers be inconvenienced by the noise, odor, and vibration? Not if they are literally sealed in a mechanically ventilated saloon provided with padded walls. Of course, the quarters will be cramped, but not more so than in the NC flying-boats. They cannot walk upright; but they can lie comfortably on couches. Moreover, the passengers will be provided with every luxury. Their quarters will not only be ventilated, but supplied with warmed air. If the spectacle of an ocean dotted with ships interests them, they can enjoy it by looking out of their port-holes. There will even be electrically cooked hot food prepared by a small cook, probably a Japanese, who must be a veritable genius. He will act as steward, purser, deckhand, and maid-of-all-work.

It Will Have to Be a Flying-Boat

The POPULAR SCIENCE MONTHLY flyer must be a flying-boat, for it is impossible to make a preliminary run at high speed on wheels in so large and heavy a machine. The machine that Mr. Dienstbach has in mind can vault into the air only if it can carry its load at maximum speed.

Suppose the machine were mounted on ice-boat runners, and suppose that the ice area were infinite. In other words, a flying-machine thus mounted on runners would gather speed, travel faster and faster, until finally it would rise into the air. So long as the preliminary run is fast enough, the heavy load can be lifted. A way must be found to run or glide over liquid water as fast as it is possible to slip over ice. Much has been done in this direction by the hydroplane, but nothing comparable with ice-boating.

The fuel-tank of Raynham's Martinsyde—it is large for obvious reasons

This solution is offered: Increase the hydroplane speed by reducing the long, wetted, adhesive hydroplane surface, and give that surface such a shape that the maximum lift is attained with the least drag. This becomes possible if the machine is able to rise clear of the water on one step in front—a step of correct design.

Now, this small hydroplane area will lift the whole load only at very high speed, and very high speed cannot be attained until the whole weight is lifted. We seem to be running around in circles. The only solution is to make this same small surface lift exceedingly even at slow speed, while the hull of the flying-boat is still in the water and offering therefore much resistance to onward progress. This end could be attained by what the airplane designer calls a variable camber surface.

By camber is meant the curvature. It is hard to change this camber in the wing of an airplane; in fact, it has not been successfully done, because the complex construction necessary makes the wing either too heavy or too flimsy. But in a hydroplane variation of camber becomes feasible. Remember that in the water steel can be used, something solid and thick; the construction can be simplified. A hydroplane with a variable surface would act like a kind of crow-bar, a long lever to lift the craft. Hydroplane surfaces can be placed directly below the load and can be controlled from their centers.

You have only to picture to yourself a well in the hull above this adjustable step or hydroplane, much the same kind of a well that receives the centerboard of a cat-boat. In this well is a row of hydraulic cylinders. The pistons emerging from the cylinders are fastened to a flexible steel plate lying normally flush against the bottom of the hull—a plate reinforced at the

Popular Science Monthly's Two-Hundred-Mile-an-Hour Transatlantic Monoplane

If the Atlantic is to be crossed regularly by commercial flying-machines, they must be vessels very different in type from the NC planes. Mr. Carl Dienstbach has designed the two-hundred-mile-an-hour Popular Science Monthly transatlantic monoplane. It is an elaboration of the Loening construction.

fastening points by strong lateral steel ribs.

Pump the cylinders full of water or empty them to a variable degree, and the steel plate can be made to bulge out or to flatten; any degree of concavity can be obtained. The location on the hull is such that if it be given no curvature—only a slight downward slant from front to rear—it constitutes the step so familiar to motor-boat speeders. With the help of subsidiary vertical surfaces adjoining it and moving in harmony with it (vertical surfaces that are slight prolongations of the hull's sides), it performs the familiar function of a step—a step that may be folded in the air against the hull so that it will offer no resistance. If the step be given a steep slant and a suitable curve, that accelerates the impinging water so sweetly downward that no eddies occur (exactly as a high lift wing acts in the air), and a trifle of a reverse "S" curve at its tail end to dismiss the stream smoothly, it needs must give a strong upward pressure at lower speed as well, while the hull is still in the water. The hollow space behind the lowered plate and the vertical side plates communicates, of course, with the air through the well above.

Getting Off the Water

Let us watch the step in action. We start with a marked curve to the hydroplane to lift the hull out of the water at low speed. When the hull is well out we reduce the curve and increase the speed. Finally all the weight is carried at extreme speed on the small front step. A similar step behind the center of gravity serves as an elevator in the water.

There is also a small vertical rudder which projects into the water and which is low enough to remain there after the tail has been raised by the elevator. Of course, the aerial controls help these water controls far more than in the ordinary flying-boat because the water speed is so much higher. Once the propellers are running, side balance is maintained entirely by the usual wing ailerons. These ailerons are very long, nearly as long as the wings, and across them blows the strong slip-stream of the propellers.

Since air resistance is so important, we must look for the utmost cleanness of line in flight. We have not an ounce of fuel to waste. The hull of the flying-boat must be given a better streamline than is to be found in the hulls of the famous NC planes. And, above all, it must be possible to fold away the side floats or pontoons that support the outer wings. Of course, this is no original idea. It has been found difficult to fold away the wheels of land machines, because they must be strong to stand severe shocks, and yet light. But floats, which are al-

ways necessary when a single center hull is employed, need not be called upon to withstand heavy shocks. Therefore, as our drawing shows, they can be swung back into recesses in the wings and covered with sliding screens when the machine is in motion. With the slip-stream side control just described, they are required only when the craft is at rest on the water.

The very size of the monoplane solves the propeller problem. The propellers can be mounted out on the wings, so that they can be driven through bevel gears by the athwart-ship engines. Nothing is detracted from efficiency, because the single reduction gear can be embodied in the bevel gear.

So solid and thick is a monoplane wing of the Loening type that there is ample strength and space for the propeller shaft mountings. In order to attain the speed desired—two hundred miles an hour—six Liberty engines and six propellers (four in front and two in the rear of the wings) are specified to attain the best compromise between efficiency and structural strength. The length of tubular shafting required is only a slight disadvantage; on dirigibles such shafting was employed long ago.

It Can Live in Rough Seas

The radiators have been borrowed from the Curtiss models, and likewise the long ailerons. Mr. Curtiss has given us a radiator of minimum resistance that has great cooling efficiency. Mr. Dienstbach has moved it from the sides of the fuselage to the top and shaped it like a long trunk. It will then act somewhat like a fin; but the chief advantage is that it is possible to utilize the exhaust as it is utilized on a locomotive—to send an extra strong draft through the radiator, cooling it in spite of the still further reduced head-resistance.

A craft of the compact type that the POPULAR SCIENCE MONTHLY has in mind can live in a really rough sea when unable to rise from it. Must it wallow helplessly? Not at all. It proceeds on its own power, runs through a storm faster than it connects with a destroyer. The flyer will always start and alight in moderately sheltered water.

When we fly to Europe we shall not need a string of destroyers across the ocean to help us in an emergency, nor need we wait patiently day after day until the weather conditions are favorable. If transatlantic flying is to be commercial the crossing must be made according to a time schedule. The time-tables may be as elastic as that of a steamship so far as arrival is concerned. If that ideal is to be realized, speed is necessary—extreme speed which makes it possible to cope with contrary winds without lengthening the trip immeasurably beyond fuel endurance.

Finding Your Way among the July Stars

How observatories use the stars in correcting standard time

By **Ernest A. Hodgson,** *of the Dominion Astronomical Observatory*

IN the article for June it was pointed out that, although our sun appears to rise and set approximately 365 times a year, yet the earth rotates upon its axis 366 times, as shown by the meridian passages of a star.

The interval between successive meridian passages of a star is called a "sidereal day." The interval between the successive meridian passages of the sun is called an "apparent solar day."

Now, the length of a sidereal day is always the same, but it fails to keep step with our apparent solar days. The latter are not uniform, so clocks cannot be made to follow them. Thus neither "day" is practical.

We must therefore adopt an artificial time system. Since the true sun does not move eastward among the stars at a uniform rate, we may suppose an average or mean sun to do so. It may be thought of as moving uniformly in the equator, rather than in the ecliptic, in such a way as to complete the circuit in a year. It will now transit our meridian at uniform intervals, and, as it is never far from the true sun, it will give us a day that keeps step with the apparent solar day. The interval between successive meridian passages of the mean sun is known as a "mean solar day." Twenty-four sidereal hours are equal to 23 hours, 56 minutes, 4.091 seconds of mean time.

"Standard Time"

Artificial as this time is, it will not suffice in these days when two cities, separated by many miles in an east-and-west line, wish to do business with comfort. For the mean sun will transit the meridian of the easterly place (i. e., mean noon) before it does at the city to the west. This difficulty led to the dividing up of the country into time belts, each approximately an hour wide, and assigning to each the mean time of the center of the belt. This is known as "Standard Time."

Now, on top of all the other artificial arrangements comes the daylight-saving scheme, thrusting Standard Time an hour forward in the spring and restoring it to normal again in the fall.

The importance of accurate time cannot be overstated. An observatory can give time to within the hundredth part of a second. Removing from the operation (for the sake of simplicity) all the necessary refinements that are thrown about it, we may look upon the method as being somewhat as follows.

A telescope is set up to rotate about a horizontal axis in such a way that it always points in the meridian. In an adjacent room a sheet of paper is drawn along by clockwork under a fountain-pen. As long as the pen is still, a straight line is drawn. But every second the pen is twitched by a magnet operated by the sidereal clock of the observatory.

How the Observation is Made

To suppose a concrete case, let us say that the observation is to be made on the stars at about 8 hours, 46 minutes, 30 seconds sidereal time. Some time before, the paper is started and the hour, minute, and second marked on the line drawn by the pen. If the paper moves, say an inch a second, the interval between second-marks must be an inch.

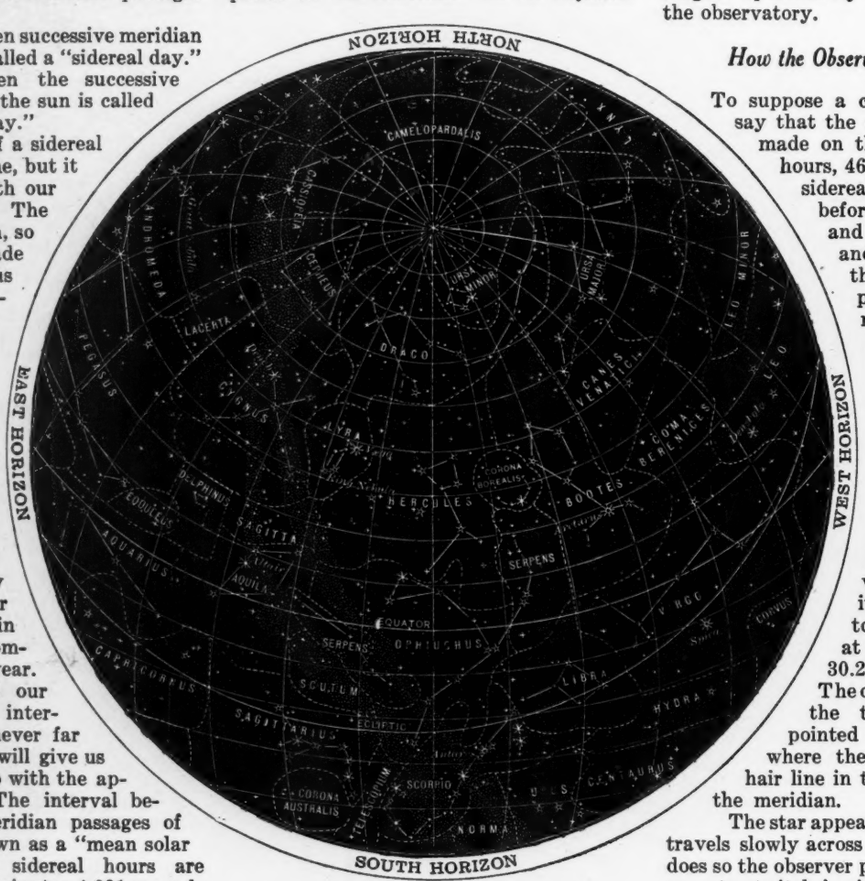
The magnet that twitches the pen is also connected electrically to a push-button beside the telescope. A star has been selected which we know, from its position in the sky, to cross the meridian at 8 hours, 46 minutes, 30.26 seconds exactly. The observer looks through the telescope, properly pointed toward the point where the star will cross. A hair line in the instrument marks the meridian.

The star appears in the telescope and travels slowly across the hair line. As it does so the observer presses the button and an extra twitch is given to the pen. The sheet is removed. The position of the twitch is measured and found on measuring to have occurred at 29.76 seconds. The clock, then, registered 29.76 seconds when it should have registered 30.26 seconds. It is therefore .50 seconds slow.

Converting Sidereal to Mean Time

The conversion of sidereal time to mean time is a matter of mathematics. The true sidereal time can be found by applying the determined correction to the sidereal clock. The mean time corresponding can therefore be computed and the mean time clock correction found. This time can be converted to standard time—again a matter of mathematics, and if necessary a further change made to give daylight-saving time.

This, then, is the manner in which we get our time from the stars. Let us remember that, though the stars enable us to have a time system, the system itself is entirely the work of man and is almost as artificial a system of units as are the systems of length and mass.



The Star Map for July

The map above is specifically arranged for the latitude of New York, but is approximately correct for any part of the United States, northern Mexico, or southern Canada. It shows the appearance of the sky at the following dates and times:

June 7, Midnight.	July 23, 9 P. M.
June 15, 11:30 P. M.	July 30, 8:30 P. M.
June 22, 11 P. M.	Aug. 7, 8 P. M.
June 30, 10:30 P. M.	Aug. 15, 7:30 P. M.
July 8, 10 P. M.	Aug. 22, 7 P. M.
July 15, 9:30 P. M.	Aug. 30, 6:30 P. M.
	Sept. 6, 6 P. M.

The magnitudes are indicated on the map by stars of various kinds as follow: 0, open center; 1, eight points; 2, six points; 3, five points; 4, four points; 5 is indicated by a single point. Eastern Standard Time.

The Popular Science Monthly *is publishing every month an article like this by Mr. Hodgson. If you feel that these articles can be made more helpful, write to the editor. And if there are questions that you would like to ask about stars, send them along.*

The Planets for July

WITH the exception of the telescopic planet Uranus, all the planets are grouped close together during July, and none are far from the sun, as the planet map shows.

Mars, being west of the sun, is a morning star, rising just before the sun.

Jupiter is so near the sun that it will not be visible. It is in conjunction with the sun on the 20th of the month.

Saturn is fairly close to the sun also, but will be visible for a short time just after sunset.

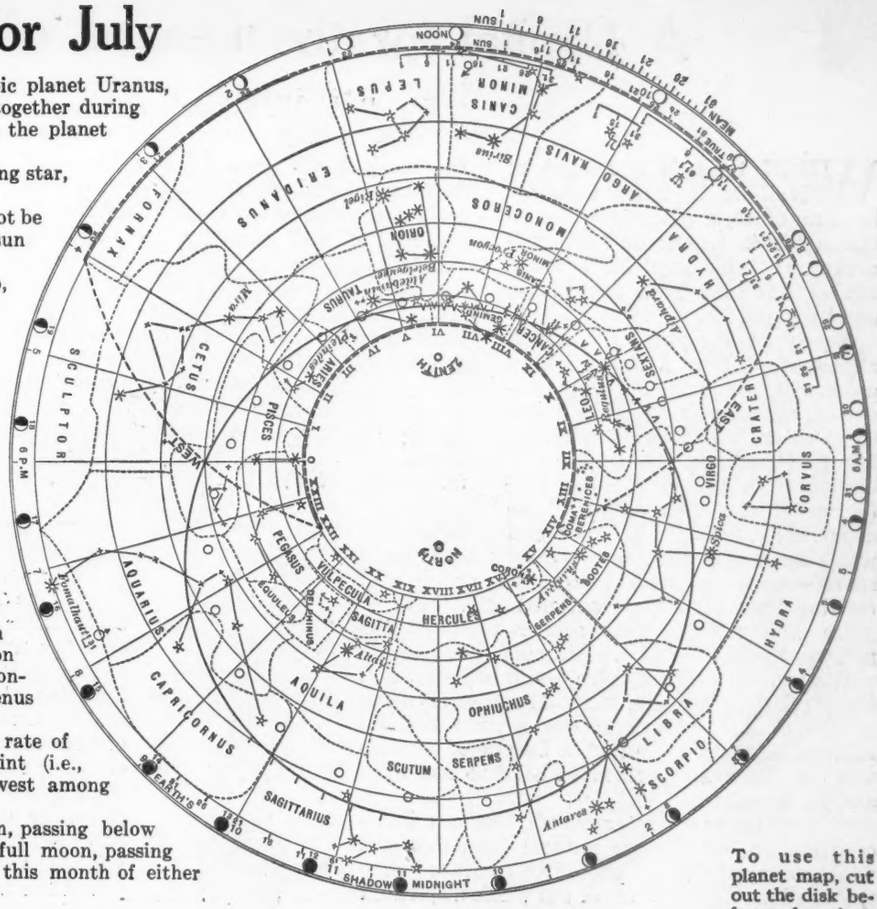
Mercury is an evening star throughout the month, reaching its eastern elongation (i.e., the point where it is farthest east from the sun) on July 18.

Venus continues to set as an evening star. It reaches its greatest eastern elongation on July 5. It will be a brilliant object in the western sky during the early evening, and will be the only planet that will make any notable showing during the month.

The following are the only conjunctions of planets with the moon worth noting. Venus on the 1st and again on the 30th. Saturn on the 1st and again on the 28th. Venus and Saturn are in conjunction with each other on the 1st, Venus being slightly to the south of Saturn.

Note the extremely variable apparent rate of Mercury. It reaches its stationary point (i.e., it begins to retrograde or pass to the west among the stars) on the 31st.

The moon avoids the sun at new moon, passing below it, and it avoids the earth's "shadow" at full moon, passing above it. There is, therefore, no eclipse this month of either the sun or moon.



To use this planet map, cut out the disk below and use it as explained in "How to Use the Planet Map"

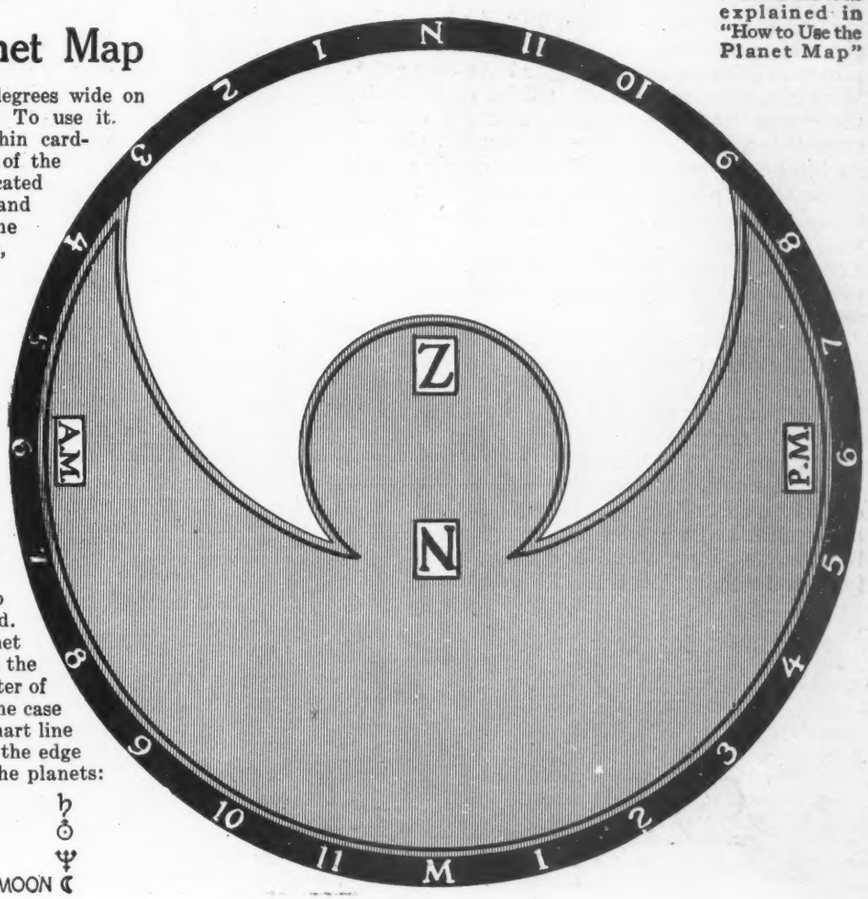
How to Use the Planet Map

THE planet map indicates a belt 30 degrees wide on each side of the celestial equator. To use it, proceed as follows. Take a sheet of thin cardboard and on it trace the outside circle of the map, and also the sections of circles indicated by the broken lines. Cut out the disk and from it cut out the section bounded by the dotted circles. On it write in North, Zenith, East, West, A.M., P.M., Noon, Midnight, and the hours indicated by Roman numerals at the edge opposite the radiating lines.

Now pin the disk, center to center, over the map. To see the section of sky visible at any hour of any day in the month, turn the disk until the required hour is opposite the required date on the chart line of the mean sun. Now, keeping the disk fixed with respect to the map, turn both until the opening is at the bottom as you hold the map before you. Turn to the south, and the stars will be readily picked up by glancing up from map to sky. The planets can then be determined.

To find when any given star or planet will rise, transit, or set, turn the disk until the body is on the eastern horizon, in the center of the cut-out, or on the western horizon, as the case may be. Look opposite the date on the chart line of the mean sun and read off the time on the edge of the disk. Following are the signs of the planets:

MERCURY	☿	SATURN	♄
VENUS	♀	URANUS	♅
MARS	♂	NEPTUNE	♆
JUPITER	♃	SUN ☉ AND MOON ☾	



A Capital for the League of Nations

By F. W. Fitzpatrick

For nearly twenty years before a League of Nations was generally discussed or even seriously thought about, an International Society was hard at work preparing for it. This Society took official and tangible form some five years ago, when nearly all the learned, professional, and scientific international societies banded together to establish a center for their meetings and headquarters. King Emmanuel of Italy and President Poincaré of France are among its permanent officers. F. W. Fitzpatrick of Chicago is the Commissioner for the United States. We have asked him to prepare this article on the world capital.—EDITOR.

WHEN there is a League of Nations it must certainly have an office, a place in which to transact its international business—a capital! This need for a world capital has long been anticipated and prepared for.

Nearly twenty years ago a man already famed as a sculptor and economist, Hendrik Christian Andersen, conceived a "World's Scientific Center" with its university and its post-graduate course in all branches; a school for the professors of the universities of all countries; wonderful libraries and museums; a world forum; a meeting place for international sports—really a world exchange or general clearing-house for all international activities.

He also realized that sooner or later the nations would tire of maintaining great armaments and navies, that there would be better and closer relations between them all rather than the groups of an Entente in one section and an Alliance in another; in fact, a League of Nations was the vision that presented itself to Andersen and his associates.

Such a League must assuredly have a headquarters, so, what more natural than that the world's scientific center should be combined with this headquarters and out of the whole a splendid world's capital be evolved?

For the past eleven years Mr. Andersen has given his entire time and effort to this wondrous project. His sacrifice and labor have been great. With Mr. Hébrard, of Paris, official architect for the French Government, and a splendid corps of specialists and artists, Mr. Andersen has planned an ideal city, monumental but eminently practical in all its parts, and has had surveyed many desirable sites for such a world's capital, at Tervuesen in Belgium, in Switzerland, at a point near Paris, and another on the Jersey coast. But the most favored today is just outside of Constantinople.

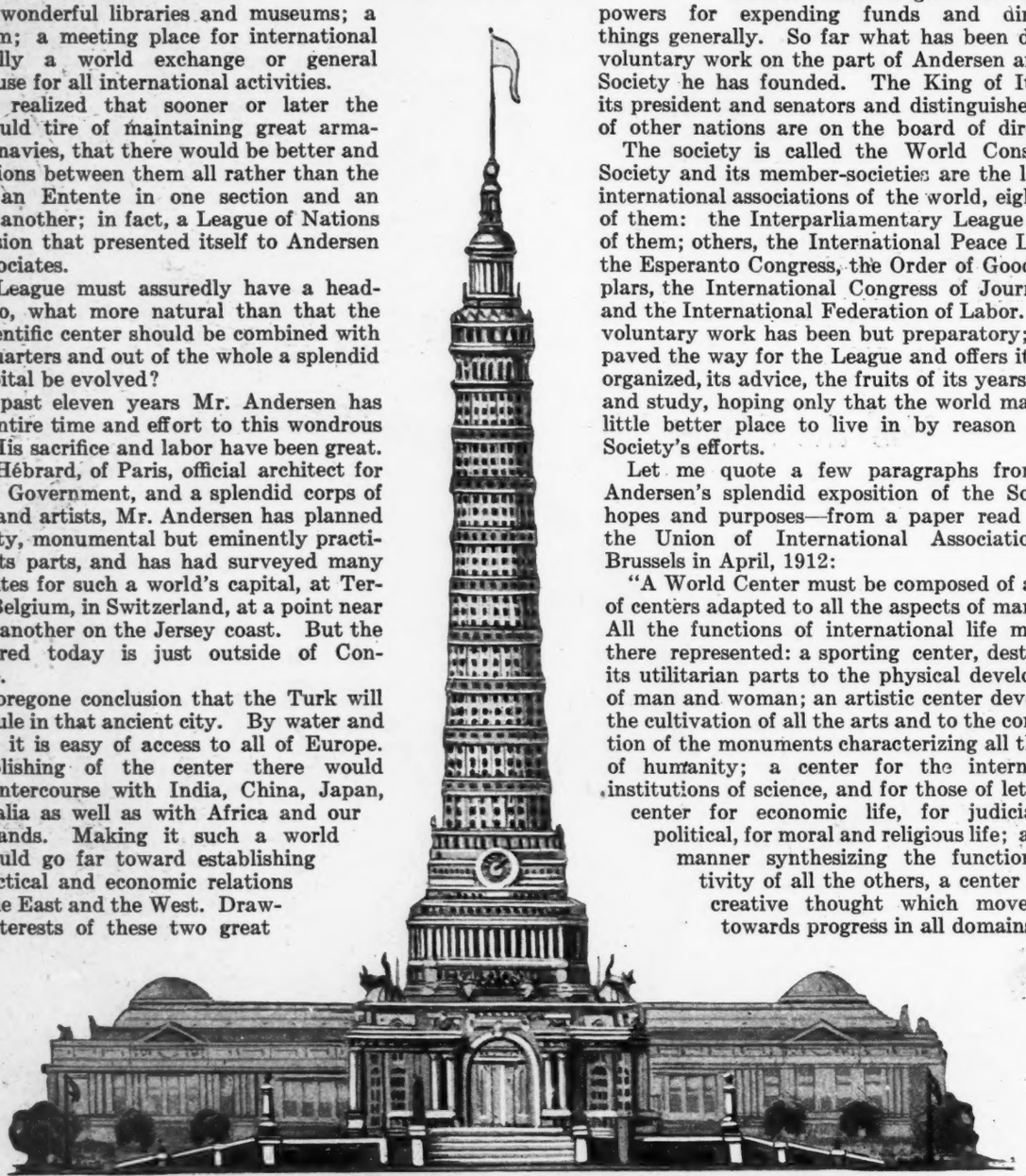
It is a foregone conclusion that the Turk will no longer rule in that ancient city. By water and by railway it is easy of access to all of Europe. The establishing of the center there would facilitate intercourse with India, China, Japan, and Australia as well as with Africa and our Western lands. Making it such a world capital would go far toward establishing better practical and economic relations between the East and the West. Drawing the interests of these two great portions of the globe toward a central point of contact would naturally further the expansion and binding together of the world by more fraternal ties. It would be one of the most ancient cities of the world, one replete with historic associations and of infinite charm, already the Mecca of all travelers, a city mellowed by age.

Of course the actual selection of a site, the work of constructing the city, must be carried on by the officers of the League, to whom all nations would delegate the necessary powers for expending funds and directing things generally. So far what has been done is voluntary work on the part of Andersen and the Society he has founded. The King of Italy is its president and senators and distinguished men of other nations are on the board of directors.

The society is called the World Conscience Society and its member-societies are the leading international associations of the world, eighty-six of them: the Interparliamentary League is one of them; others, the International Peace League, the Esperanto Congress, the Order of Good Templars, the International Congress of Journalists, and the International Federation of Labor. This voluntary work has been but preparatory; it has paved the way for the League and offers it, when organized, its advice, the fruits of its years of toil and study, hoping only that the world may be a little better place to live in by reason of the Society's efforts.

Let me quote a few paragraphs from Mr. Andersen's splendid exposition of the Society's hopes and purposes—from a paper read before the Union of International Associations at Brussels in April, 1912:

"A World Center must be composed of a series of centers adapted to all the aspects of man's life. All the functions of international life must be there represented: a sporting center, destined in its utilitarian parts to the physical development of man and woman; an artistic center devoted to the cultivation of all the arts and to the conservation of the monuments characterizing all the ages of humanity; a center for the international institutions of science, and for those of letters; a center for economic life, for judicial and political, for moral and religious life; and in a manner synthesizing the functional activity of all the others, a center for the creative thought which moves man towards progress in all domains."



The World Capital has a scientific center, art center, libraries, museums, meeting place for international sports, and headquarters for a League of Nations

How to Test the Strength and Stability of Magnets

PERMANENT magnets, usually in the form of horseshoes, are used for many purposes, especially in the construction of magnetos for certain types of automobiles. The usefulness of such magnetos depends upon their strength and their magnetic stability. These qualities depend upon the nature of the steel of which the magnet is made, and upon the degree and efficiency of its magnetization. The initial strength and the stability of a magnet should be known before it is put to work.

An instrument has been invented for determining and measuring the degree of magnetization and the stability of horseshoe magnets. A coil capable of rotary movement, to which is attached a pointer traversing a scale, is supported between two iron pole pieces. This movable system and the scale are enclosed in an air-tight box. The pole pieces extend through the walls of the box into contact plates to which the two poles of the magnet under test are applied.

When a known current is allowed to pass through the coil, the pointer is deflected in proportion to the strength of the magnet, the degree of which is indicated on the scale. The magnet is not affected by this test.

Horseshoe magnets such as are used in magnetos are first tested for strength and stability by the instruments shown here. The usefulness of the magnet depends on the nature of the steel and the degree and efficiency of its magnetization

For testing the stability of a magnet, two adjustable coils (solenoids) are provided which are located in front of the contact plates and fit around the legs of the test magnet. If a current is allowed to pass through the solenoids in the proper direction, it will demagnetize the magnet until the pointer of the testing instrument points to zero. The value of the current required to bring about this result is measured by an ammeter and indicates the degree of the stability of the magnet tested.

By this test the magnet is deprived of its magnetic power. To make it useful it must be re-magnetized. In practice the test for initial strength is applied to every magnet in a lot, while only a few samples, picked out at random, are subjected to the stability test.

The current for the movable testing coil is derived from a single dry cell, that for the solenoids from a storage battery. The solenoid current is regulated by rheostats.

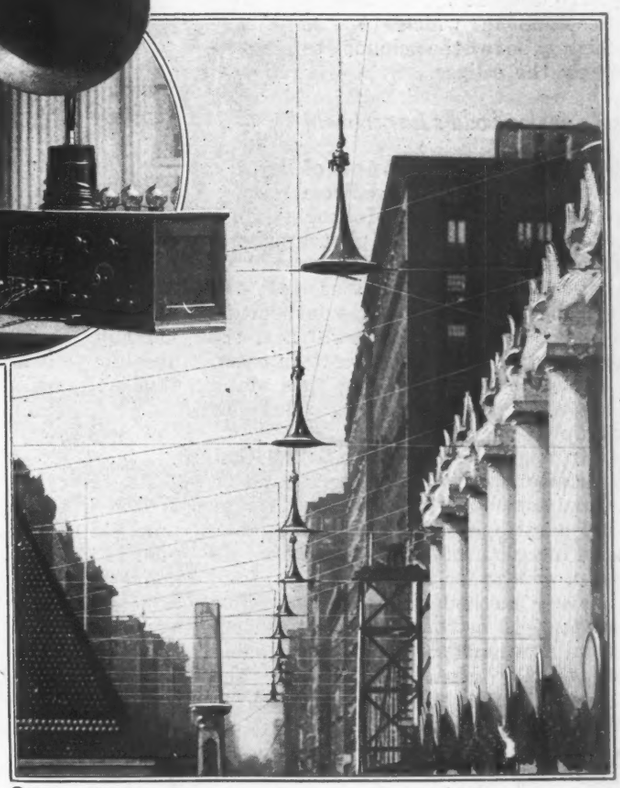
A Voice from the Sky

AN aviator three thousand feet in the air said, "Buy a bond!" and crowds of people in front of the Treasury Department Building in Washington heard him plainly. Why? Because a "magnavox" was attached to the receiving end of the wireless apparatus. A magnavox—it means "great voice"—is an amplifier which greatly increases the power of the ordinary speaking voice. This particular amplifier was invented by Edwin Pridham and Peter L. Jensen.

The great feature of the set is that the flyer's transmitter is noise-proof. When the aviator said "Buy a bond" his Liberty motor was roaring only a few feet away; yet the people below heard only his voice. Because his transmitter was carefully enclosed? No; because his transmitter was carefully exposed so that all external sounds would hit both sides of the diaphragm and neutralize each other. As a result the diaphragm would not vibrate. Then, when the aviator talked, that extra vibratory force exerted on his side of the diaphragm was the only vibration that registered.

Because of this anti-noise quality, the magnavox is especially adapted for use in factories.

In the anti-noise "magnavox" the diaphragm of the transmitter is exposed; ordinary sound waves hit it on both sides and it does not vibrate; then the speaker's voice alone will cause vibrations that can be heard



These horns are all connected to one transmitter; when someone speaks into it, his voice will thunder up and down the street

© Keystone View Company

Flying Above the Clouds to Catch the Eclipse

Astronomer would mount his camera on a seaplane and soar to meet the sun

A TOTAL eclipse of the sun can never last more than eight minutes. Usually it lasts much less. An astronomer will travel thousands and thousands of miles to an out-of-the-way place, in order to make the most of a few precious minutes. The actors in a play are no more carefully rehearsed than are astronomers stationed at the various instruments. No one member of an eclipse expedition sees the eclipse as a whole; each one performs the special duties assigned to him.

What if cloud or fog should steal between the earth and the sun? What if it should rain? All these elaborate preparations, all this tedious traveling, go for nothing.

But fogs are always low-lying—never more than a thousand feet thick. Therefore, if cloud or fog creep in between the earth and the sun, the solution is to climb above them and see the eclipse in all its uncanniness.

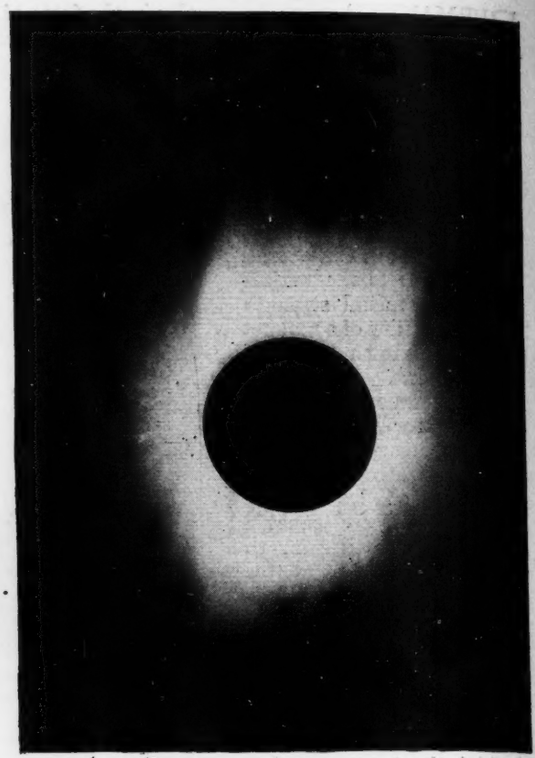
No wonder, then, that astronomers are interested in the experiment undertaken by Professor David Todd, of the Amherst College Astronomical Observatory, of using a seaplane in which to rise high above the clouds to view the eclipse.

Professor Todd's Experiment

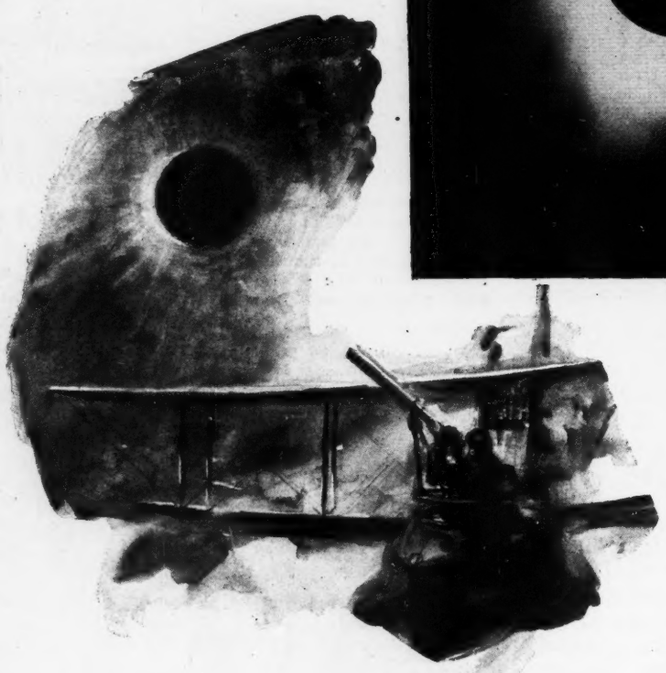
With the assistance of United States Naval officers and a seaplane, Professor Todd set out to take photographs of the sun's eclipse which occurred on May 29. It was planned that the steamship on which the expedition sailed would stop at a point near the equator off the South American coast, launch the seaplane, and then stand by while the astronomer tried out his plan.

It might have been expected that Professor Todd would be the first to carry astronomy into the air. He is the most enthusiastic, indefatigable, and ingenious of eclipse observers. He even went so far, some years ago, as to devise a method of operating a whole battery of astronomical instruments from a central point, but was unable to employ his invention for the observation of the particular eclipse because the sky was at the time obscured.

Although at the time of going to press the results of Professor Todd's experiment have not been reported, it may be doubted if the plan of using a seaplane is practicable. Such is the vibration caused by a seaplane's engine that the steady platform that must be provided for all telescopes becomes a shaking base hardly suitable for Professor Todd's purpose. To be sure, it was his intention to offset the vibration by an elastic mounting of the telescope; but anyone who knows anything at all about the inertia of movable parts will admit that absolute steadiness can hardly be thus obtained.



What is the astronomer's chief object of solicitude during a total solar eclipse? The corona. Only during the few minutes of a total eclipse is the corona ever seen by earthly eyes



What can the astronomer do when, just as the moon is about to obscure the sun during a total eclipse, a cloud intervenes and obscures the view? Pack up his instruments and go home. No wonder that Professor Todd decided to send a seaplane, armed with telescopic cameras, above the clouds, and thus make sure of getting pictures to take home with him

A More Practical Scheme?

Professor George E. Hale, of Mount Wilson Observatory, has a far more practical scheme, to our mind. His plan is to send an unmanned balloon above the clouds, and to steady the cameras, which the balloon will carry, by means of a gyroscope. Professor Hale plans to study the corona—that ghostly appendage which surrounds the sun, and which is visible from the earth only during an eclipse—at any time.

As we ascend in the atmosphere of the earth we finally reach a point, perhaps at an altitude of thirty miles or more, where the sky is not blue, but jet-black.

The sky is blue because the air is filled with countless billions of dust particles that diffuse the light of the sun. In the inky canopy of the sky above the region of dust particles, where the air is extremely thin, the stars appear in their proper places even in broad daylight. And the sun is a great blazing ball hung in the blackness. Its wonderful corona, the chief object of study during a total eclipse, gleams in all its pearly beauty.

Should Professor Hale Succeed

If Professor Hale succeeds in realizing his plan, we need not wait for a total eclipse in order to study the corona but we can photograph it whenever we please and study it day by day.

Tree Wireless

Connect your wireless set to a tree and hear the world talk

TREES may be used as receiving and even sending antennae in radio-telegraphy and -telephony according to Major-General George O. Squier, Chief Signal Officer of the Army. With the "Floraphone," as he calls it, not only have signals been received and sent by radio apparatus using live trees for antennae, but messages including multiple telegraphy signals have been received from local stations, airplanes in flight, other trees and the principal European stations.

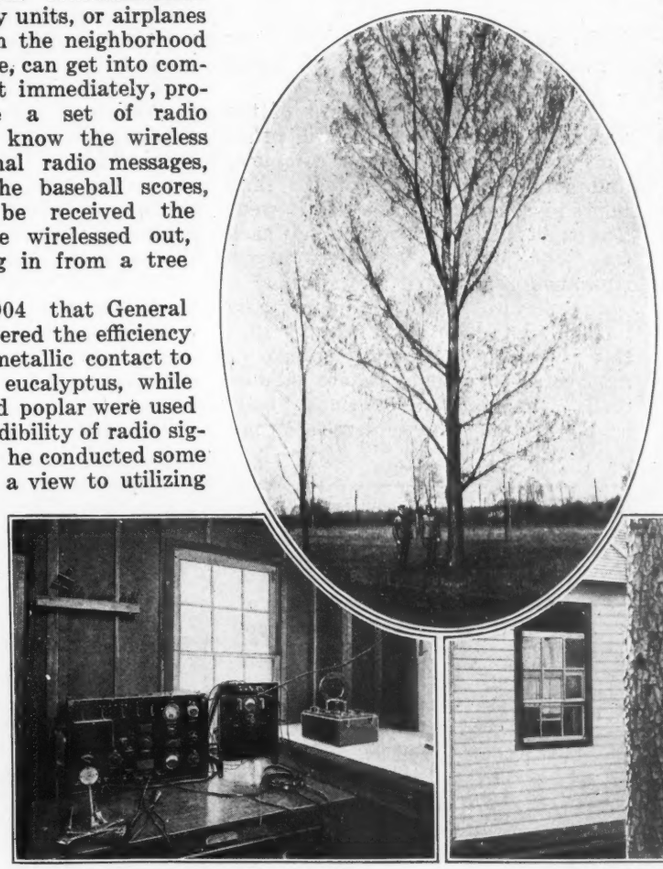
Explorers in unknown lands, farmers miles from communication centers, lost Army units, or airplanes forced to land, if in the neighborhood of a good-sized tree, can get into communication almost immediately, provided they have a set of radio instruments and know the wireless code. International radio messages, news bulletins, the baseball scores, and such, can be received the moment they are wirelessed out, by simply cutting in from a tree station.

It was in 1904 that General Squier first discovered the efficiency of using a direct metallic contact to trees, principally eucalyptus, while later oak, pine and poplar were used to increase the audibility of radio signals. Thereupon he conducted some experiments with a view to utilizing growing trees as antennae for radiotelegraphy. During the course of summer Army maneuvers in California, it was found that the regular Army buzzer telephone and telegraph did not operate with an ordinary ground, due to the dry season and the soil, but became operative when connected with a nail driven in the trunk or roots of a tree. A report made by Dr. Squier was forwarded to the War Department in 1904, but it was not until the recent war that any great practical development was carried out.

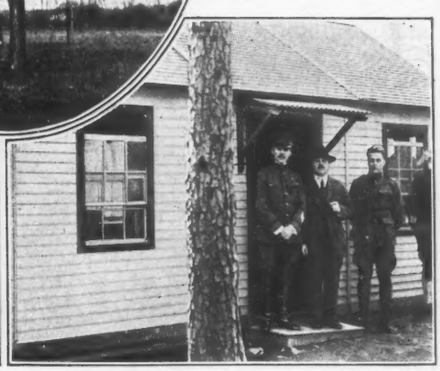
In connection with the development of transatlantic radio work, undertaken to provide against a possible interruption of the submarine cable system, the Signal Corps established a chain of special receiving stations in the United States to record enemy and Allied radio messages for the information of the Army. In this work the efficiency of growing trees as receiving antennae for this service, using the most modern apparatus, was thoroughly tested and upon this work, conducted secretly, General Squier reported for the first time on April 25th, before the Physical Society of America assembled at the Bureau of Standards in Washington where demonstrations were made.

Almost immediately the Signal Corps experimenters discovered that with the sensitive amplifiers now in use it was possible to receive signals from the big European stations, simply by laying a small piece of wire netting on the ground under a tree and connecting an insulated wire to a nail driven into the tree within an outline of its top. Further experiments led to the discovery that one of the best receiving arrangements was an elevated tree earth terminal in the upper part of the tree top, and an earth, or ground, consisting of several short pieces of insulated wire sealed at the outer ends, so as to radiate from a common center, and buried beneath the surface of the ground near the base of the tree. Such a tree antennae was also used as a multiple receiving set over widely different wave lengths, receiving either from separate terminals, at the same or different heights of the tree, or in series from the same terminal.

The same apparatus was also used for transmitting and receiving telephone messages, although this was only tried out successfully over short distances. Wire and wireless methods were found to be very readily linked up by this system. Radio telephone messages from airplanes were received and transferred by wire to the city of Washington. Tree wireless possesses great possibilities, according to General Squier and his aids.



Apparatus for working with tree wireless. (Above) A tree aerial

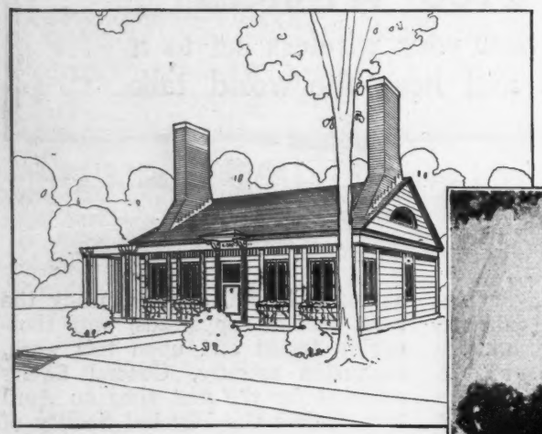


General Squier now "plugs in" on any tree and hears the news

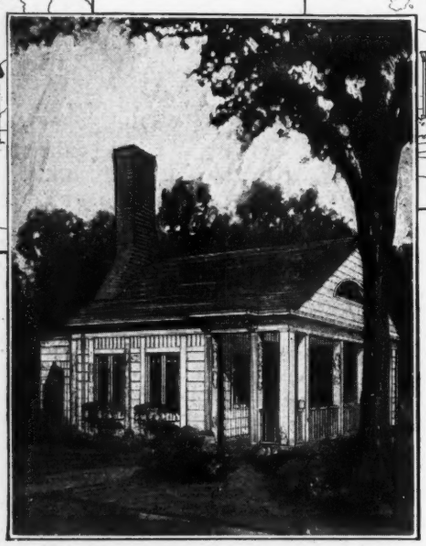
The House that Grew

A young architect's dream and how he made it come true

By
Vandervoort Walsh



Then a baby came and more rooms were added. Two fireplaces kept the house warm during the winter



Just large enough for a newly married couple is the little house in the beginning

The family grew, as families will, which necessitated enlarging the house still further by adding the end wing

ARCHITECTS, as well as other people, dream about the kind of home they hope to have some day. But they have the advantage of being able to place their dreams on paper. The writer presents here his little home, in the hope that it will be helpful to young people in planning houses for themselves.

It occurred to him that he could build his home on the instalment plan by erecting a small house, carefully planned for future artistic growth. He saw plenty of houses that had started as little shacks and been built up to large living-places, but the final results were hodge-podge affairs, made without definite plan.

He therefore dreamed about the kind of house he would like to live in, and then cut it down, here and there, until he had a little house that could be built for about $1,900 in normal times. Then a complete plan was worked out by which this little house could, by additions through the years, be made to grow into the house he imagined.

He found that it could be done in five distinct stages. At every stage of the game the house would look complete and artistic, and at no time would it look unfinished. The time between the steps of growth could be as long as the builder's pocket-book required. If a period of hard time came, and he wanted to save, he would not have a big instalment bill to pay or a large mortgage interest to meet, for his house, would be as far as it went, his own. In other words, when he built the first small step of his home, he would be able to own it without mortgage, because it cost very little, and then he could enlarge it as his savings permitted, and still avoid a mortgage.

Now, the perspective views of the various steps of this house will prove that each one shows a house complete, and surely the picture of the final house gives no hint of the way it grew. The same is true of the plan. At each step, the house is complete in its equipment, and yet it grows logically.

The pictures show this house to be built of white-painted clapboards; but this is not necessary. A stucco, or brick veneer, or shingle surface could be used. The shingles would cost about 5.3 per cent more per square foot than the clapboards, the stucco about 32 per cent, and the brick veneer about 52.6 per cent more per square foot. But it must be appreciated that although this seems like a very great difference, it is not really so much when you consider that on the total cost of the house an increase of only about 7 per cent would be incurred by brick veneer, which is the most expensive. In other words, the cost of the material on the exterior walls is a very small part of the cost of the house as a whole.

In order to make additions as simple as possible, it will be noticed that the outside walls are divided into panels by wood pilasters. In this way, the house can be increased by units. The same precaution is taken with the roof. A horizontal board is carried around at the top of the first floor, and when the roof is lifted for the second story, this board acts as a belt course from which to begin the design of the second floor. If brick or stucco were used, these same panels of wood could not be dispensed with, for they are the secret of making new additions simple.

There was room a-plenty for all the grandchildren when the house was completed. A more artistically designed house no one could desire

In the beginning the house has only three rooms and a bath; but it is really a very comfortable and cozy little place, as the picture shows. The outside dimensions of it are 23 ft. 6 in. by 29 ft., and the kitchen wing is 12 ft. 6 in. by 14 ft. It has a porch with an entrance in its narrow end, which, it will be noted, becomes the main entrance of the next addition. There is also a back porch and ice-box entry, and a stairway to the cellar, where there is a laundry. The dining-room and living-room are combined, which is not at all a disagreeable arrange-

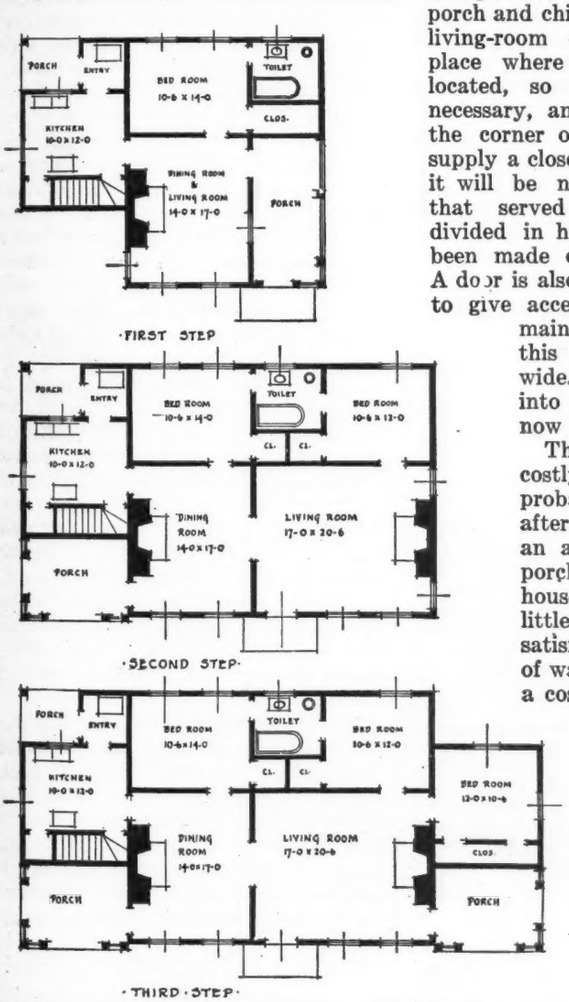
ment when economy is desired. A fine big bedroom, with a large bath and closet, adjoins. Of course, it must not be overlooked that there is also a small attic. It is a little doll house, perhaps, from the outside, but inside it is much more livable in than the usual four-room apartment.

Everything Carefully Planned

Now, it will be noticed that everything in the building of this house is arranged for expansion when the time comes. For instance, the chimney is built high enough so that when the day comes for building a second story it will not have to be altered. The porch is also built of as solid timbers as the rest of the house, in anticipation of the next step, when it will be converted into part of the living-room. The floor does not have the usual slope of a porch floor, but is prepared to be the under floor of the new room.

The ceiling joists also are designed for the future. Instead of making them of light 2 x 6-in. timber, they are 2 x 10-in.; for some day they will be the joists of the second floor. Open spaces are boxed in the wall also, for the easy instalation of future plumbing and steam-pipes for the second floor.

The door from the living-room to the porch is designed so that, when the next addition is made, it can be removed and placed between the present porch columns under the entrance hood. The window on the porch will also be removed from the partition and used in the bedroom of the new extension. The roof is so built that it can be easily raised when the time comes. This is done by having rafters rest on a double plate. The upper plate is bolted to the lower, and can be quickly released when the time comes. The rafters are spiked to the upper plate. When the roof is lifted, the jack-screws raise the upper plate, when the bolts that hold it to the lower plate are released, permitting an easy upward movement of the entire roof. The under plate remains in position, and serves as a foundation of the second-floor walls. The cornice line is built so that the raising will not destroy the appearance of the building. In the cellar is a sectional steam-heating boiler which permits of the addition of new sections as the building grows.



As shown in the plans, the house was designed chiefly for comfort at all stages of construction

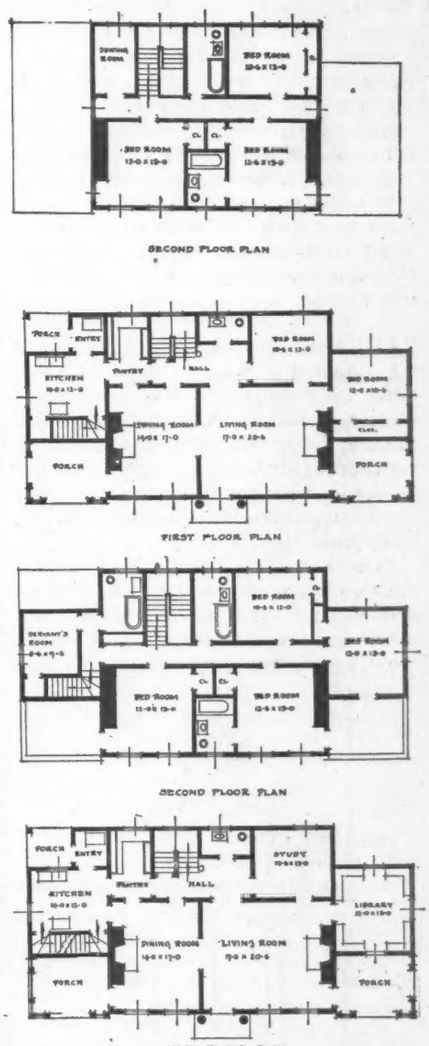
Reaching Out and Up

Now, let us suppose that after a number of years enough money has been saved to complete the next step in developing the house. It will be seen in the plan that a living-room, a bedroom, and a new porch and chimney are added. The living-room extends out from the place where the old porch was located, so that a new porch is necessary, and this is provided at the corner of the dining-room. To supply a closet for the new bedroom, it will be noticed that the closet that served the old bedroom is divided in half, it having purposely been made deeper than necessary. A door is also cut into the partition to give access to the toilet. The main body of the house in this second step is 30 ft. wide. The front door opens into the living-room, and is now permanently located.

The third step is not so costly as the second, and it probably could be made soon after the second. It gives an additional bedroom and porch. In this stage the house is a very complete little bungalow, and is quite satisfactory for many years of waiting. The next step is a costly one, since a second floor must be added and the roof raised.

But, as the years go by and the results of prosperity pile up, the thoughts of extending the house sky-ward may be very welcome. Now, in order to do this, some means must be provided for getting upstairs. A stairway and a stair-hall must be built. Since the plan has had this in view from the beginning, it is not difficult to secure the space. What was formerly a bedroom can now be divided into a hallway and pantry, and the bath-room can be cut down to the size shown, to serve as a downstairs lavatory.

In this fourth step only the roof over the central part of the house is raised. The pictures do not show this, but it is easy to see if the roofs of the wings shown in the picture of the fifth step are blotted out with the hand. It will be noticed that by lifting the roof of the central part of the house three new bedrooms are added, two toilets, and a sewing-room. On the exterior at the front, two large columns are erected to tie the design together and give dignity to the house. It is not necessary to build the railing around the top of the porches; this can be added when the final step is taken,



To those contemplating house-building with a limited supply of capital, no better suggestions can be offered

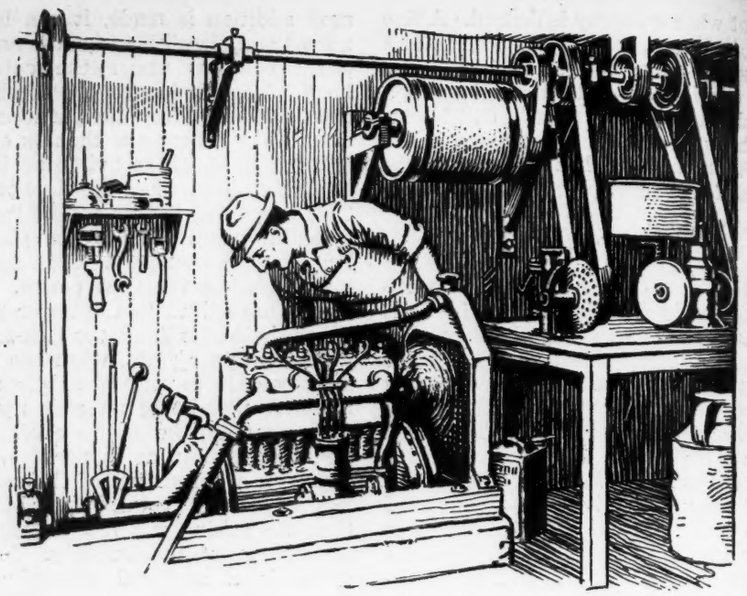
which consists of raising the roofs over the two wings.

When this last step has been reached, and the wings on the second floor have added two new bedrooms and a back stairway, the house is complete.

What Can Be Done With An Old Car

By E. L. Candler

Winner of the second prize in the Popular Science Monthly's contest



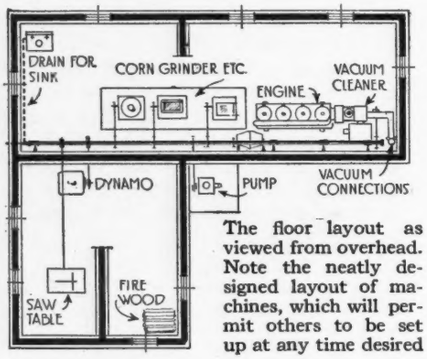
E. L. CANDLER, of Grand Canyon, Arizona, won the second prize of $100 in the POPULAR SCIENCE MONTHLY'S *$300 contest for the best use of an old automobile, discarded on account of accident or the antiquity of its mechanism. His idea is shown in the diagrams below, which indicate how he set up the engine of his wrecked car in the cellar of his house, and made its power drive a vacuum cleaner to help his wife with the housework, operate the water pump, corn grinder, cream separator, dynamo to furnish current for electric lights, a butter churn and a saw table for cutting the winter's supply of kindling wood. This method of utilizing an old car should be met with approval by other motorists, for there are many wrecks, with sound engines, which can be bought for a song from insurance companies.*

In relating how he came to devise the plan shown herewith, Mr. Candler writes:

"LUCK was against us. We had only owned our car for a short time when we were in a wreck which completely demolished the rear end of the car, but did not damage the engine. After thoroughly considering the matter we decided we could use the engine to good advantage and purchase an entirely new car.

"Our home is a plain, old-fashioned house, of five rooms, kitchen, dining- and living-rooms. Above these are the bed-rooms, while below the dining-room and kitchen, forming an L, is a shed, used principally for sawing and storing firewood.

"We advertised and obtained a second-hand power vacuum cleaner at a low price and which, having been little used, was in excellent condition. The engine and cleaner were mounted and connected together by a clutch on a cement foundation in one corner of the cellar, and a pipe run on the outside of the house from the cleaner to the four main rooms and supplied with a hose connection in each room. The cleaner blows the dust into a large, closed barrel where a spray of water settles and carries it away through the drain from the sink. The engine also exhausts into this drain, which has the effect of deadening the sound.



The floor layout as viewed from overhead. Note the neatly designed layout of machines, which will permit others to be set up at any time desired

"For sawing wood, running the cream separator, churn, bone and corn grinders, corn sheller, dynamo (used in lighting the house) and the water pump, a line shaft, carrying pulleys, runs underneath the floor of the kitchen and is belted to the several machines.

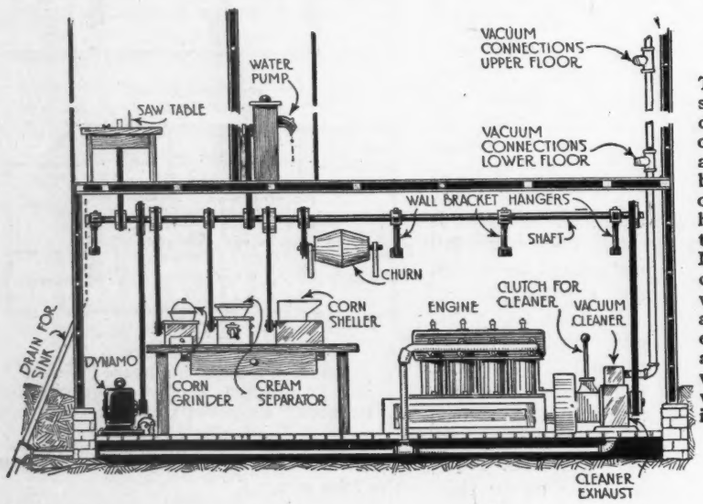
"Other parts of the wrecked car were used as follows: The damaged tires were used for half soles and heels for work shoes, lining for wagon brakes, gate hinges and screen door bumpers and for trunk feet, which prevented the trunk scratching the floors, broom holders and strips nailed to the building to support growing vines.

"The inner tubes were useful for making fly swatters, sink stopper (disk form), gaskets for pipe unions, fruit jar rings, insoles for shoes, packing for pump and vacuum cleaner, weather strips for doors, a window cleaner and a pair of leggings for wet weather; also part of one of the tubes was made into a float for use in the swimming pool.

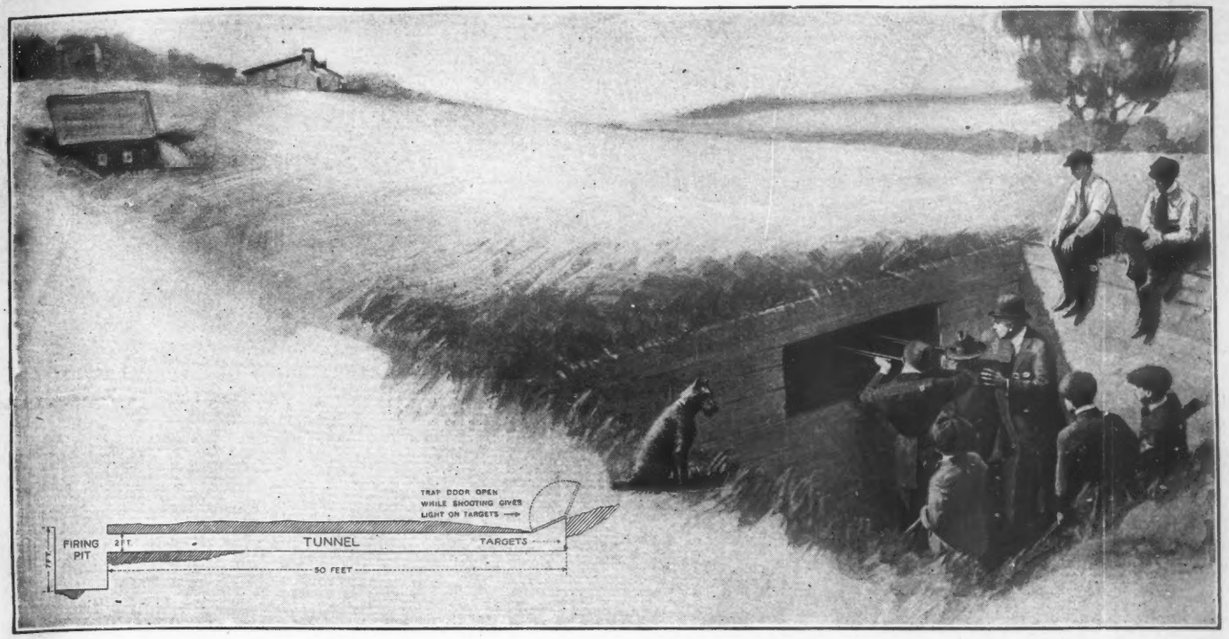
"The framework we used for braces; the seats we mounted in a lattice summer house; the top we made into a playhouse for the children, and the front wheels we used on a cart.

"Considering the use we made of all the parts and materials of the car, the loss by the wreck was not so great. Almost any one can make good use of their old cars in some of these ways."

It seems to us that some of the many automobile engines that can be bought second-hand could be made use of along these lines without waiting for a wreck.



These diagrams suggest other individual means of making use of an old automobile engine which otherwise would have to be sold to the junkdealer. Naturally, the cooling system would have to be adjusted differently; but this is a trivial matter when compared with the service it would give



An underground rifle range

Ideal 50-foot range designed by W. J. R. C. boy

Sharpshooter Medal

SHERIDAN BARRINGER of Hillsboro, Illinois, designed the rifle range shown here which earned for him the W.J.R.C. Special Service Pin.

Barringer is 12 years old and a member of the Winchester Junior Rifle Corps. This range shows what a little inventive genius can give you in the way of a safe range for rifle shooting. The plan needs no explanation. The picture shows how simple the range is to build.

Of course, not every boy has a back yard or field where he can build such a range. For the city boy, a safe backstop for .22 shooting can be rigged up in the cellar or attic. All you need to stop a .22 bullet is a packing box filled with sand.

No boy, no matter where he lives, need give up hope of getting in on this manly and fascinating sport of rifle shooting simply because he doesn't happen to have a rifle of his own or live out in the country.

Start a W. J. R. C. "Unit" with your friends

The Winchester Junior Rifle Corps will help you from start to finish in rigging up an indoor or outdoor range.

The W.J.R.C. gives you all the instruction necessary to become a real expert in the use of a rifle. It provides for officers, supervisors, and adult instructors to make your shooting safe.

It costs you nothing to join the W.J.R.C. There are no dues and no military obligations. Any boy or girl not over 18, who is in good standing in his or her community, is eligible.

Membership in the W.J.R.C. covers the entire United States. There is hardly a town now that has not at least a small "Unit" where boys are learning to become expert riflemen and are competing among themselves for the famous Winchester Marksman, Sharpshooter and Expert Rifleman Medals.

Get together with half a dozen of your chums, join the W.J.R.C. and organize a regular unit which will be officially recognized by National Headquarters. Any boy who starts a Unit gets a Special Service Pin. And when you have enough marksmen in your Unit you will be matched against other Units.

Get the official plan and handbook

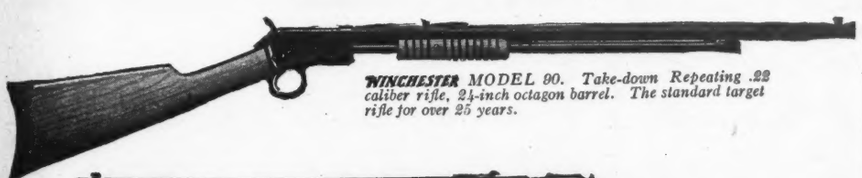
Write today for the Winchester Junior Rifle Corps "Plan for organizing a W.J.R.C. Unit," and for the official handbook, "How to handle a rifle safely." This booklet tells you all about the W.J.R.C. and describes in detail the fine points of shooting.

If you are a boy scout, or member of any other boy organization, state what organization and give the name of the official in charge.

National Headquarters

Winchester Junior Rifle Corps
275 Winchester Ave., New Haven, Conn., U.S.A.
Division 720

Standard types of .22 caliber Winchester Rifles, popular with members of the Winchester Junior Rifle Corps.



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Winchester Junior Rifle Corps
National Headquarters, 275 Winchester Ave.
New Haven, Conn., U. S. A. Division 720

Gentlemen:

Please register my name as a member of the Winchester Junior Rifle Corps, and send me a membership button and certificate of membership. Also tell me how to organize a Local Unit of the W.J.R.C.

Very truly yours,

Name _____

Street Address _____

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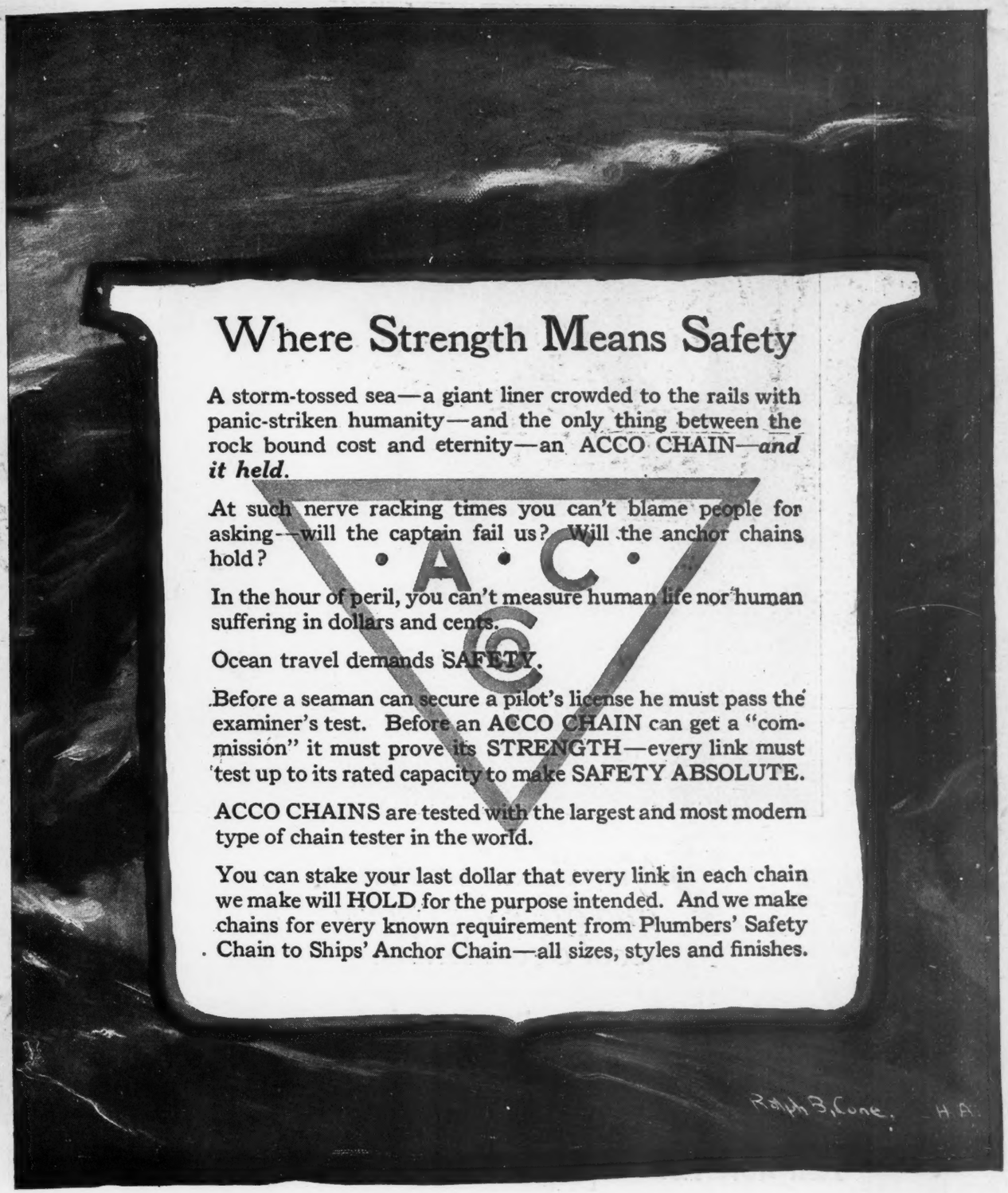
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At such nerve racking times you can't blame people for asking—will the captain fail us? Will the anchor chains hold?
• A • C • C •
In the hour of peril, you can't measure human life nor human suffering in dollars and cents.
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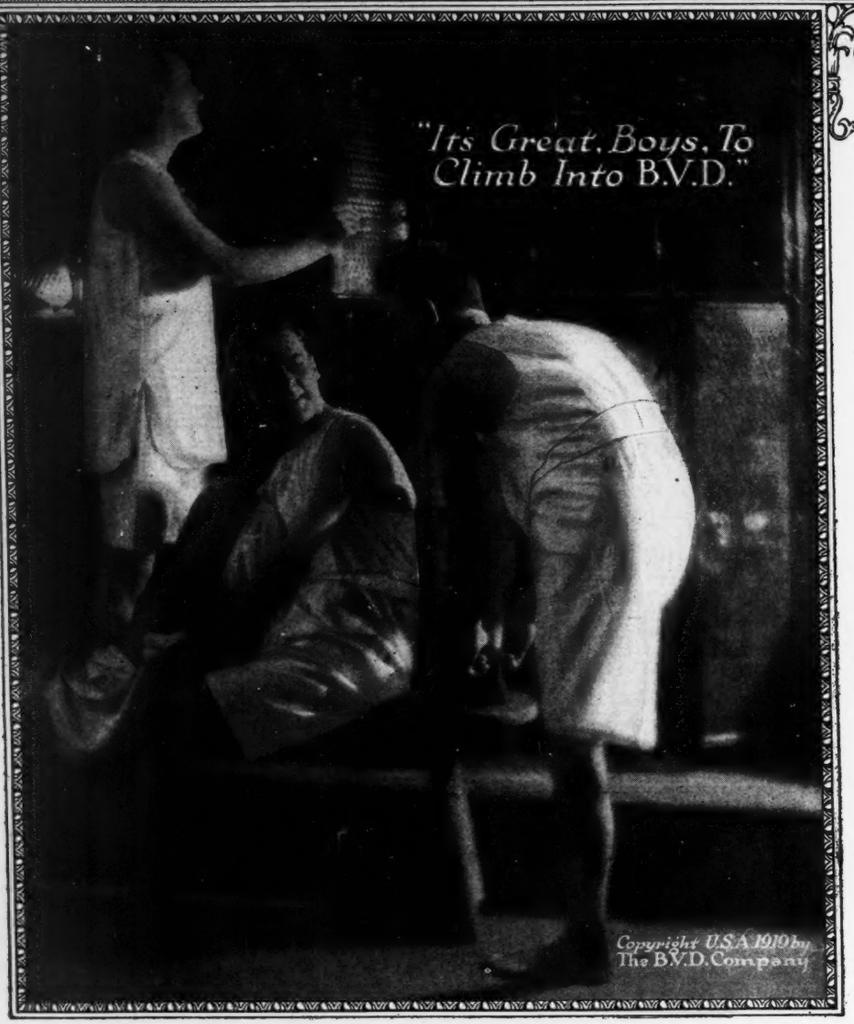

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A Lathe Made from an Old Bicycle

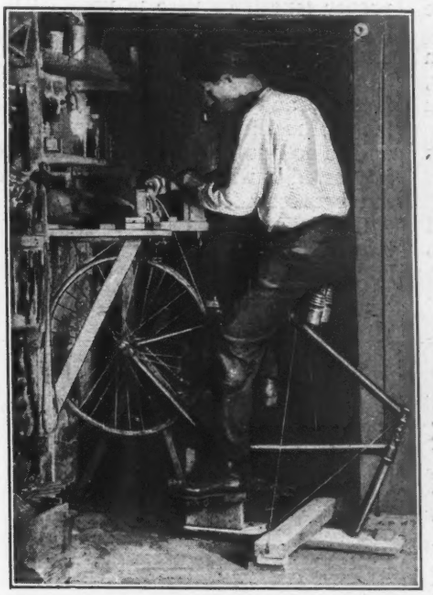
Why not pedal instead of using a hand crank?

By E. Bade

DID you know that a complete lathe, upon which you can make all kinds of work, whether flat, cylindrical, spherical, long or short pieces, can be made from odds and ends and an old bicycle? No? Well, here's how it is done:

First, a convenient space in the cellar or outhouse is selected, about 3 ft. in length, where a permanent stand can be erected. Two beams are fastened to the ceiling and to the floor next to the wall. From these two supports should project a table made of wood, about 2 by 1 in., which will be heavy enough if it is properly attached. Projecting 6 in. from the table proper are two beams upon which two 2-by-1-in. boards are fastened at equal distances from each other, all connections being made with screws.

The two boards are the most important part of the lathe-bed, the rest of the table being utilized for tools or for unfinished work. The carriage is fastened to the front board with iron clamps, so that it can be moved to the place where it is needed. The head- and tail-stocks are fastened to the second board in a like manner. The head-stock consists of a wooden pulley fastened to an iron core which turns in a U-shaped bracket. The tail-stock, with the feed-screw, consists of a wooden frame upon which the axle of a bicycle is fastened. One end is pointed so that it can engage the wood as it is turned. The feed-screw must be made movable, and this can be achieved by fastening one nut of the axle to the wooden support.



This contrivance is an advantage over other kinds of power lathes for it is not so tiring

The back wheel of the bicycle is placed under the wooden pulley of the head-stock and a suitable frame made, so that the bicycle wheel can be turned by means of the pedals. The bicycle is braced by two wires on each side which must be pulled taut.

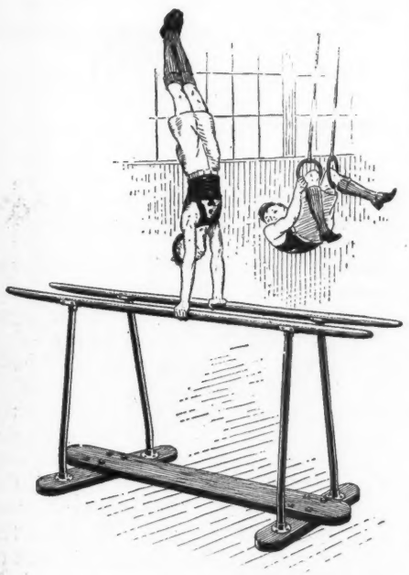
Strong cord or thin rope will serve the purpose of a belt just as well as leather if it is spliced together. The desired tension can be given by moving the frame of the bicycle forward or backward a little.

A Gymnasium Apparatus for the Home

A pair of parallel bars

By L. B. Robbins

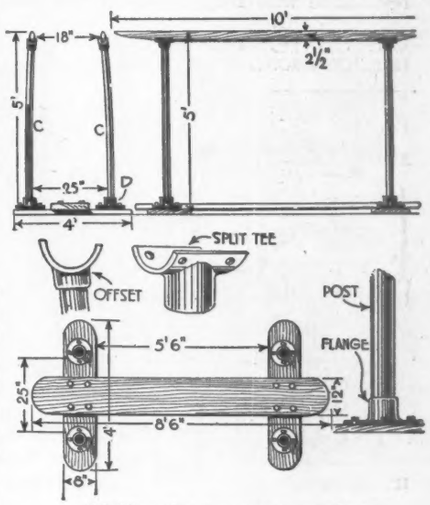
PROBABLY the most abused piece of gymnastic apparatus is the parallel bars. Consequently, in building much care should be taken to build it with an eye towards strength as well as design.



To be healthy one must first exercise. Here is an excellent way to become fit

Use any suitable hard wood such as hard-pine or oak. Cut out one piece for the backbone 8 ft. 6 in. long, by 12 in. wide, by 2 in. thick. Round off the ends and bevel the edges. The two cross-pieces are then cut from the same stock, 4 ft. by 8 in. wide. These should be treated in the same way. Bolt them to the backbone so that their inside edges will measure 5 ft. 6 in. apart, using four bolts to each piece, countersinking them on the under sides, so as not to scratch the floor. A pair of iron floor flanges with a 2-in. opening should then be fastened to each cross-piece with lag screws. Place them equal distances from each end of the cross-pieces so that the inside faces of the pipe openings will be spaced 25 in. apart. Then pieces of leather glued to the under surfaces of the ends of the cross-pieces complete the base. Varnish them and set aside to dry.

The posts are composed of 4 lengths of 2-in. galvanized pipe 4 ft. long. The bottom ends are threaded to screw into the flanges, and T-pieces, which have been sawn in half lengthwise along the horizontal part, are screwed to the top ends. The halves of the T's which are left are then bored with four small holes, one at each corner. Now, jam the bottom end of each post between two solid objects capable of withstanding the strain, and inserting an iron rod into the other end, exert enough pressure to slightly bend the pipe at the bottom end until they are of such a shape that with the bottom ends screwed into the flanges the top ends of each pair will be just 18 in. apart. This will take considerable strength and patience, but after it is done the rest is easy. Set them in proper position and hold them there by burring over a bit of the top of each flange with a cold chisel. When the posts are in place the fact that the T's are off-set is obvious as the tops of the posts are now slanting in and the top edges of the T's would do the same if they had not been sawed in half. As it is they will now carry the bars evenly.



Making the apparatus requires only tools found in every home

A Home-Made Soldering-Iron Heater

By W. E. Day

EXPERIMENTERS, as well as professionals, find occasional use for a soldering-iron, and if it is not the electrical kind it must be heated.

A simple and inexpensive heater can easily be made to run on the 110-volt, 60-cycle alternating current which is generally supplied.

You must first consider to what use the instrument is to be put, and make its size accordingly.

A jeweler using small coppers would not necessarily need as large a coil as a tinsmith, but in either case sufficient resistance wire must be used to produce the required heat.

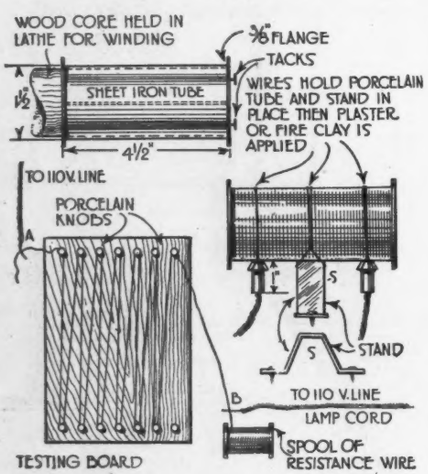
The illustrations describe a heater that one experimenter made and used with very good results. It heats a ½- or ¾-in. copper in a few minutes, or two small coppers may be heated at the same time.

At his tin-shop he made a sheet-iron tube with the regular stovepipe lick joint anywhere from 1 to 2 ins. in diameter and from 3 to 5 ins. in length, according to the size of heater under construction. At one end is a solid or closed head with a ⅜- or ½-in. flange. The open end may or may not have a flange, as the fire-clay to be used later can be made to take its place.

Whether the coil is to be wound in a lathe or by hand, it is advisable to turn out a hard piece of wood some 2 ins. longer than the tube and of such size as to slip snugly into the tube. Drilling two small holes in the solid end of the tube and driving in tacks to hold it tightly on the wood core will prevent it turning in the shell during the winding.

Next, wind a couple of sheets of mica over the iron tube for its entire length, and hold them in place temporarily by a string.

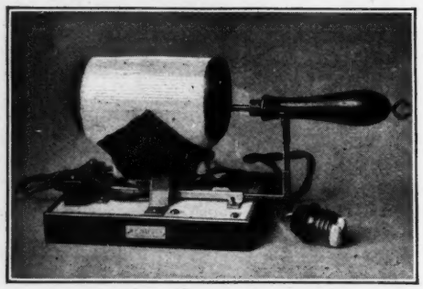
In winding the coil any kind of resistance wire may be used, but one of high resistance is far better if the proper length of wire is used. This kind requires less wire, besides taking up less space.



A brief study of the above diagram will give an idea of the simplicity of design

No. 22 or 24 wire proves very satisfactory; and as there are dozens of kinds of resistance wire on the market, and as no two people in a hundred are interested in wire, I suggest the above numbers for reference in buying it.

Obtain a smooth board 3 or 4 ft. long by 1 ft. wide. Screw small porcelain knobs, say 2 or 3 ft. apart, lengthwise, starting at *A*, winding the wire



Easy to make and just as practical as the store article is this heater

tightly back and forth, and allowing the spool end to come out at *B*. Connect one strand of the electric-light cord to *A* and hold the other strand at *B*. It will allow the so-called "coil" to heat up, and more wire may be added or wire taken off this coil until it shows a dark red its entire length, which is the proper amount of wire to use. Don't let the wire turn a white heat or it may melt and burn out the coil.

No. 24 alloy resistance wire has about 1,300 ohms per 1,000 ft., while Nichrome of the same size has 1,485 and German-silver wire only 540. The length of wire may be calculated in this way, but I have found that the testing-board above described is the safest and most satisfactory.

In winding the coil, anywhere from 20 to 45 ft. of wire may be required, depending upon the resistance of the wire used, this being determined by experiment on the testing-board.

Wind the turns of resistance wire tightly, about 1/16 in. apart, and if the required length of wire will not wind upon one layer of the coil, put on another sheet of mica and wind as before. Remember that insulation in all the construction is absolutely essential.

Assuming that the coil is wound, another sheet of mica is wound over it, being held in place by fine copper wire wound tightly about it to prevent the coil from loosening. Obtain from an electrical supply shop two porcelain insulating tubes about ½ in. in diameter, cut them down to 1 in. in length, and wire them tightly to the coil, having previously soldered each terminal to the lead in the lamp-cord, so that the joints will be in the bottom end of the porcelain tube, as in *S*. In the same manner, fasten the brass trips "lower *S*" which support the coil upon the base and be very careful of all fastenings, so that they will not cut through the mica and short-circuit the coil.

Ordinary stove lining clay may be used as a covering for the coil, plastering a thick layer about the coil as well as the back end. Try to get it moderately smooth and even, and carefully dry it out a little at a time by turning on the current and then shutting it off again. This method will prevent cracking of the fire clay.

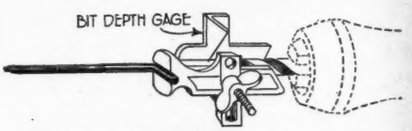
The base may be made any suitable size and faced with a sheet of asbestos upon its top.

The soldering-iron holder may be made for use with any length handle by using a square brass tube with a solid brass square rod sliding inside. This is held in any position by the thumb-nut.

Using a Bit Depth-Gage as a Hook-Driver

THE driving of hooks is a most unpleasant task, unless the workman possesses one of the special screw-eye attachments sold for the purpose. If he hasn't this device at hand, then the hooks must be driven by hand power, a slow and exasperating job, especially when a quantity of them must be driven.

This trying work can be done easily



This attachment turns the bit into a hook-driver which saves valuable time

and in short order if the carpenter owns one of the widely used interlocking bit depth-gages sold for regulating the depth of auger holes.

To use the depth-gage for hook driving, all that is necessary is to clamp it to the front end of one of the smaller sizes of bits. The device should set up so as to protrude about three quarters of an inch beyond the point of the bit. This leaves the two flanges free and makes a slot of just the proper size and shape to catch hold of the elbow portion of the screw hook.

Hooks can thus be driven with the same speed as screws. The flanges of the depth-gage hold the hook securely for driving, yet are released immediately as soon as the driving is done.—HENRY SIMON.

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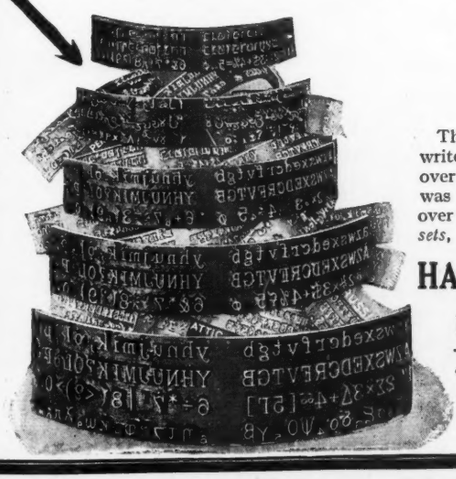

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An Inexpensive Smoke-House for the Farm

MEAT, whether cured in brine or by the dry method, will keep better, and have a great deal better flavor, if it is smoked.

This may be done in a makeshift shanty, or even in a drygoods box. Or, it may be done in a small house of wood or concrete built for the purpose, if there is enough meat to warrant its erection. However, meat that is subjected to a direct heat is apt to absorb odors and to become partially cooked, causing the quality to vary.

The smoke travels up through the pipe into the smoke-house where the meat is hung

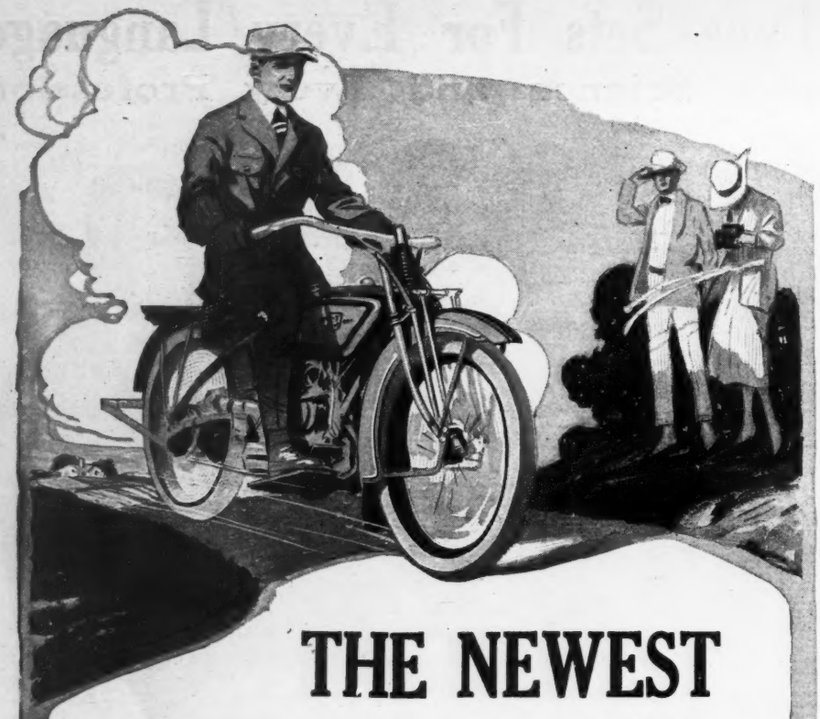
To obviate this a smoke-house similar to the one shown in the illustration was built. The combustion chamber proper is at some distance from the smoke room so that only dry smoke reaches the meat, with the result that the meat is both well smoked and dried.

The combustion chamber was erected upon a hillside, as shown, so that the smoke readily reached the smoke room by natural draft. It was of concrete and was made by digging into the bank so that a wood box about 2 ft. square could be set in, with 3 or 4 in. to spare on all sides. The space was then filled with concrete, forms being used where necessary, and a door made in the front at the bottom, about 10 in. square. The roof was made thicker than the sides and covered with earth.

Lengths of drainpipe were laid to connect the combustion chamber with the smoke-house, the first section of the pipe being laid in the soft concrete.

In the illustration the pipe is laid beneath the surface, but this is not necessary as long as the joints are tight, to prevent the escape of smoke. Over the upper end of the flue, a small house, 4 ft. square was built, with braces and beams upon which to hang the meat.

Ideas differ as to the best kind of fuel. Corn cobs are good, so is any dry, non-resinous wood. Coal would taint the meat.—DALE R. VAN HORN.



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You cannot appreciate this Harley-Davidson Sport Model or realize its great superiority without seeing it in action.

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Go prepared to take 5 to 10 days course of the ANDERSON METHOD. We guarantee to make a first class vulcanizer out of you or refund your money.

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$235 and 5 to 10 days in Any Anderson State School of Vulcanizing will start you in this most profitable business.

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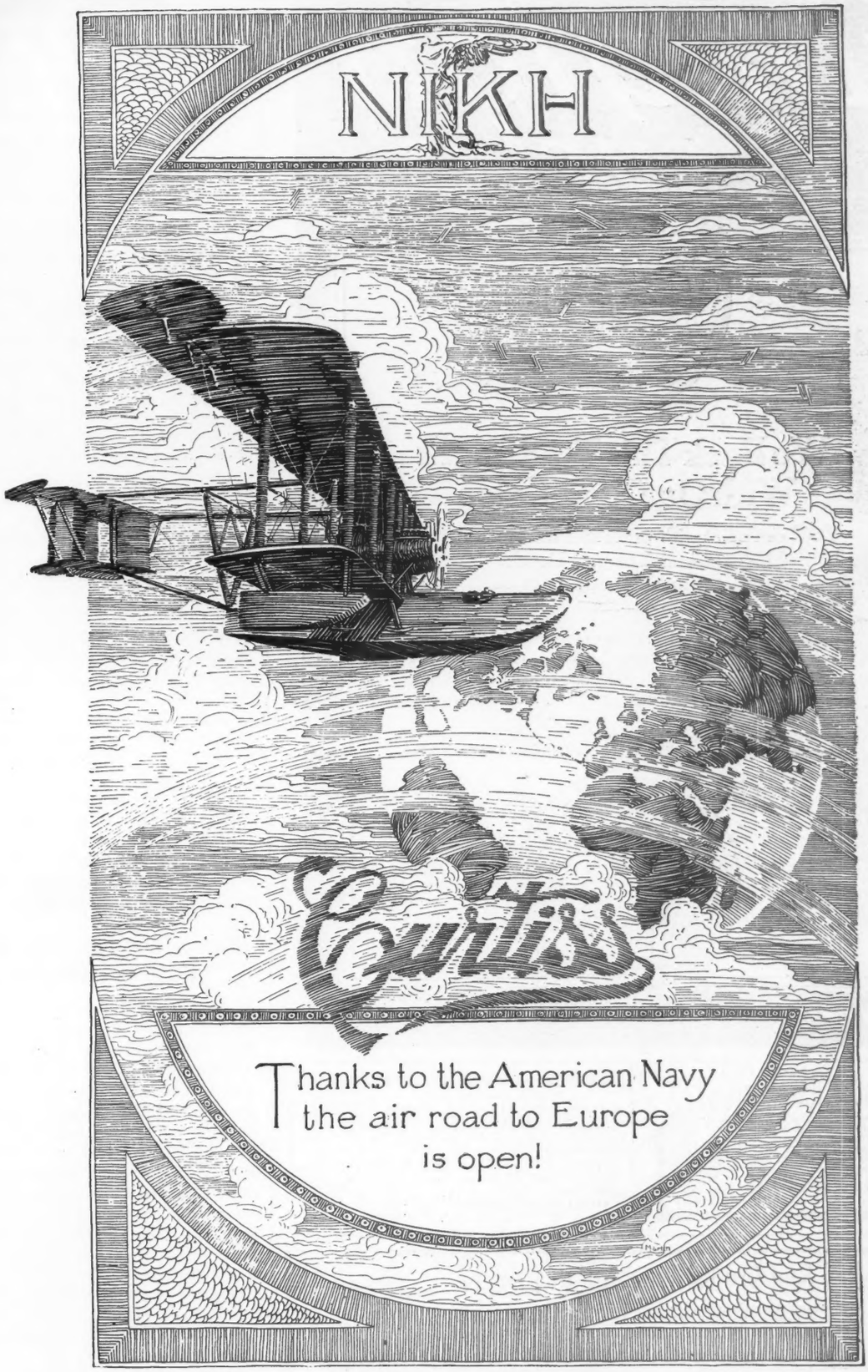
Please print your name. We receive many we can not make out.



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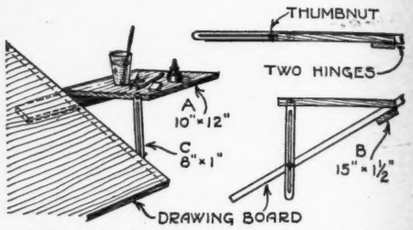
An Instrument Shelf for the Drawing-Table

A SHELF for holding drawing instruments, ink, and so forth in a convenient, level position can be easily made with a few pieces of wood, some screws, and two hinges.

Smooth up a piece of board about 10 in. by 12 in., another piece of board about 1½ by 15 in. and a narrow strip of wood about 10 in. by 1 in.

Cut a ¼-in. slot through the center of the narrow strip to about 1½ in.



With this shelf attached to the drawing-board the artist can speed up his output

from each end. In one of these ends drill a hole large enough to allow a ½-in. wood screw to turn freely in it.

The diagram shows a back view of the shelf and indicates how it is to be assembled. First, screw the hinges to one end of *A* and one side of *B*, so that when the projecting edge of *B* is screwed to the under side of the drawing table the board will form a shelf that can be adjusted at will and to any level.

The proper level is maintained by means of the narrow slotted strip and the clamp screw.

A small drawer attached to the table will greatly increase its usefulness.—FRANK L. MATTER.

Poor Contact Will Impair Battery Efficiency

MOTORISTS are sometimes at a loss to understand why the battery runs down so quickly. When trouble of this sort arises, it will be well to carefully examine the brushes on the starting motor. The storage battery supplies current through brushes to the starting motor, and it sometimes happens that these brushes are not making proper contact. This causes more or less failure of the system and often results in the rapid running-down of the storage battery. The remedy for this condition is quite obvious, once the cause has been found.

A partially run-down cell connected up with good ones in the system will cause the others to do more work than they are able to handle. Thus the efficiency of the whole battery will be very much impaired, as the cells will run down more quickly than they will under ordinary normal conditions. It is a good plan to tighten all connections at least once a week.—PETER CLUTE.

DILLON MULTI VISION LENS

What Car Owners Say

"You are at liberty to use the letters I wrote you, for the Dillon lenses have no equal in my estimation, and I have tried several others that are on the market. Yours only have given me just what I have been expecting of the others."
J. E. CAVEY, Stratton, Col.

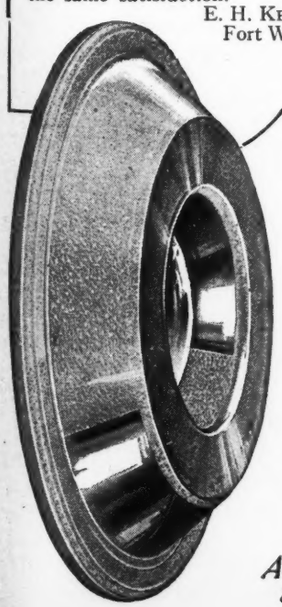
"Received the Dillon Lens and had same installed on my machine in less than five minutes. Have tried them out on the boulevards, also on the country roads, and must say that they are in my opinion the perfection of lenses. Have tried several other kinds of headlight attachments, but your lenses are the only ones that have given me a perfect and clear light."
JAS. A. COOGAN, Kansas City, Mo.

"I have found in the Dillon Multi-Vision Lens, at last, comfort in night driving. I have tried almost every other kind of headlight attachment on the market, but they are excuses compared to the Dillon. I wouldn't sell mine for $25 if I couldn't get another pair."
J. MAXIME ROY, Broussard, La.

"They are all that you claimed them to be and then some. Would not drive over country roads without them. They give a wonderful light right where you want it."
C. E. MARKHAM, Detroit, Mich.

"The Dillon lenses are the finest auto lenses I ever rode behind, and apparently perfect. Am very much pleased."
E. N. EEASONER, Oneco, Fla.

"I had the extreme hard luck of breaking one of my Dillon lenses. Would just as soon have broken a connecting rod, because I am at a loss without it, and cannot replace the Dillon with any other type of lens with the same satisfaction."
E. H. KELLER, JR., Fort Worth, Tex.



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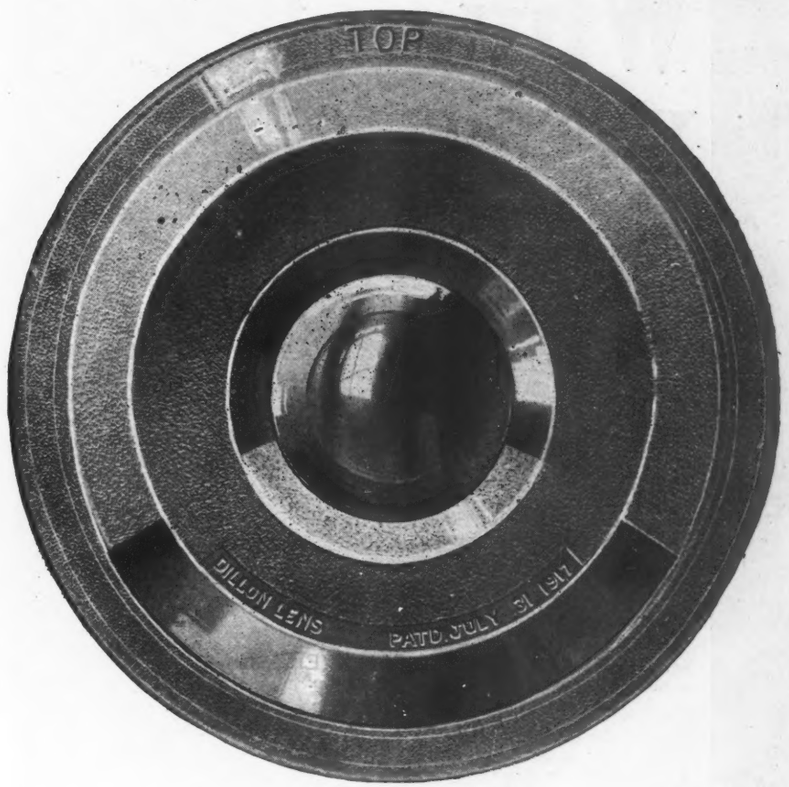

Do You Feel Safe When Driving at Night?

You may have felt that all legal lenses cut down the light and are therefore not to be considered unless under compulsion of the law.

The Dillon Multi-Vision Lens is different.

It gives you more illumination on the road than plain glass lenses, and is legal in all States.

You see the ditches and the entire roadway in almost daylight clearness. There are no dark areas, no "waves of light," no shadows. Just a fine, full illumination that leaps straight out at both sides and extends far ahead.

One short ride behind the Dillon Lens on a dark night will give you proof beyond question of its superior lighting efficiency. As driver or as passenger you will realize immediately that here at last is a lens that satisfies every desire for light, safety and compliance with the law.

Read the testimonials in the opposite column. They are typical of the thousands of letters we have received, all telling the same story of more and safer light.

The Dillon Lens gives more light with bulbs of lower candlepower than any other headlight device in the world.

Get a pair from your dealer today. Try them out and if not fully satisfied, return them and your money will be refunded. If your dealer can't supply you, order direct. Same price, $3.50 per pair, any size, postpaid. Booklet upon request.

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Why should your wife do this?

when

Kor-Ker TIRE TREATMENT

would have sealed the puncture instantly without the slightest loss of air. There would have been no delay—no danger—no dirty hard work—no weakening of the tire casing.

For seven years and in forty different countries thousands of autoists have been enjoying the luxury of riding free from the worry and care of punctures, because their tires were KOR-KERIZED, and yet to many autoists the fact that KOR-KER *absolutely seals punctures* and *stops slow leaks* seems too good to be true.

KOR-KER is a rubber preservative. Preserves your tubes and casings. KOR-KER is not a tire filler—occupies but little space.

KOR-KER doubles life of inner tubes. Tubes can be changed from one casing to another. KOR-KER reduces blowouts to a minimum by keeping tires at normal inflation, whereby at least 90% of tire troubles are prevented.

Remember that KOR-KER *preserves rubber.*

We stand back of all the above statements—they are facts that can be easily substantiated. If you cannot readily find the KOR-KER dealer in your town, write us for his name, and convincing literature.

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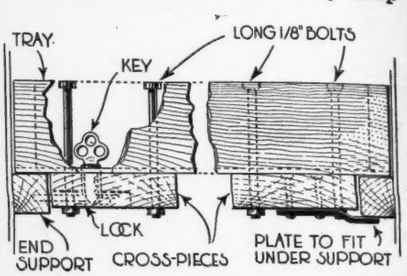
Provide Your Trunk with a Tray Lock

A SECONDARY trunk lock is always valuable, and especially so to those who possess only one room, for with this attachment one may keep



FRONT VIEW OF TRAY

The petty thief cannot get into your trunk if you provide it with this tray lock

valuables securely locked underneath the trunk tray, irrespective of the regular lock on the trunk.

The above drawing shows the manner in which a secondary lock is constructed. Connections are made between the tray and its ends.

The two cross-pieces are made from spruce 2½ by ¾ in. in width. Special ⅛-in. bolts connect these to the tray. At one end two pieces of iron are bolted to a cross-piece, with ⅝ in. of each piece projecting, to slide under the end supports. These pieces can be filed from an ordinary strap hinge and fastened to the cross-piece with 5/32-in. stove-bolts. At the other end two drawer locks are fastened to the cross-pieces. After turning the keys in these locks their catches project into the end support and form a substantial lock. The bottom is specially reinforced, as this method makes it still more difficult to gain an entrance.—M. A. WISE.

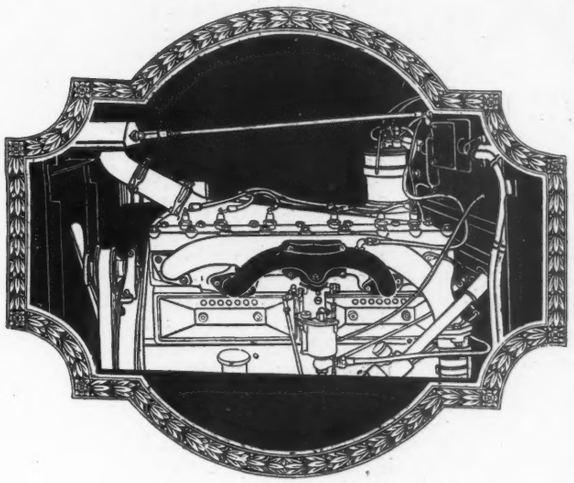
Transforming an Old File into a Reamer

A VERY handy tool for the amateur is a tapered reamer. This can be made from a medium-sized round file. The temper is first drawn by allowing it to get red hot and then gradually cooling it off. It is then ground on an emery wheel to the shape shown in the illustration, and driven into a file or chisel handle.

Holes are very often drilled too small or slightly out of line. With this reamer you can enlarge the hole by

If the file is of thick material it should be filed up on both sides

turning the reamer completely around. If the hole is to be lengthened the reamer is turned only half way around and back again.—WALTER B. WEBER.



If Engines Had Windows

IF automobile engines had windows or if they were made of glass you would understand why it is hard for most cars to start, why the cylinders and other parts must "warm up" before there is anything like smooth running, why gasoline works down into the crankcase and "cuts" the lubricating oil, why you have to take the car to the service station so often for repairs.

Through the window you would see at once that most engines of today cannot burn the so-called gasoline that is fed to them.

Gasoline is a mixture of light easily vaporized constituents and heavy kerosene-like constituents. There is not enough light gasoline for all the cars in use. It must be blended with kerosene-like fuels which the engines of today were never intended to burn.

That explains why in starting only the lighter parts of the fuel—the real gasoline—is vaporized and why the heavier part cannot be consumed until the engine warms up. And even then drops of kerosene-like fuel collect in the manifold and are swept into the cylinder where they work down into the lubricating oil and destroy the very properties that make it useful.

There is only one way out of the difficulty—to build an engine that will burn every drop of fuel, extract the last thermal unit of power out of it, so that you get all the mileage to which you are entitled and so that your repair bills will be reduced.

The Chalmers engineers have built that engine.

It is adapted to the fuels of the day because it has two distinctive features. One of these is the Hot-Spot manifold; the other the Ram's-horn shape of the manifold.

What is the Hot-Spot? Part of the exhaust heat of the engine is made to heat that part of the manifold which is struck by the jet of mixed gasoline vapor sprayed by the carburetor. Immediately the Hot-Spot vaporizes the drop of fuel by which it is struck. Only the right mixture of vapor and air is supplied to the engine.

At once all your starting difficulties disappear. In thirty seconds the engine is running perfectly. And no raw gasoline finds its way into the lubricating oil down in the crankcase.

The Ram's-horn manifold completes the work of the Hot-Spot. It supplies all the cylinders with an equal amount of mixture. And it does this because it has no corners, no sharp angles to check the flow and because the inner wall is smooth.

In most engines the manifold supplies mixture to one cylinder from which the surplus passes to another. Thus the mixture overflows from one cylinder to another. The sixth cylinder gets either very little mixture or raw drops of unvaporized gasoline.

The Ram's-horn supplies all cylinders with the right kind of mixture in the right amount.

That explains why Chalmers engines run so smoothly, why they are so cool on a warm day, why they are so efficient.

CHALMERS · MOTOR · CAR · CO.
Detroit, Mich. U.S.A.

Quality First

This is the third of a series of six bulletins in which the wonderful features of the new Chalmers will be explained.

Using DOUBLE Ratchet adjustment in a close corner

The owner of a "YANKEE" Ratchet Hand Drill No. 1530 comes to regard it with a pride that is close to the affection felt for a faithful friend. With its five different adjustments you can do work you'd never think of attempting with any drill but a "YANKEE."

Think of the possibilities of the DOUBLE Ratchet in a cramped space. The slightest movement of the crank *in either direction* gives continuous forward drive, and drills as rapidly as if a full turn of the crank could be made.

Note the five adjustments of Ratchet Shifter between small gears.

Set in the upper notch and you have a plain geared drill; in the second notch, it becomes a Left-hand Ratchet drill; in the third notch, a Right-hand Ratchet drill; in the fourth notch it is a DOUBLE RATCHET drill.

With the shifter in the fifth (or lower notch), the gears are locked for opening or closing the chuck.

"YANKEE"

Ratchet Hand-Drill No. 1530

Length 10½ in. Weight, 20 oz.

Price, $3.90

YOUR DEALER CAN SUPPLY YOU

Write for free "YANKEE" Tool Book, showing "YANKEE" Tools in action and illustrating better ways of drilling, boring, tapping, and driving and drawing screws.

NORTH BROS. MFG. CO.
PHILADELPHIA

"YANKEE" TOOLS
Make Better Mechanics

How to Build a Concrete Milk-Cooling Tank

By S. R. Winters

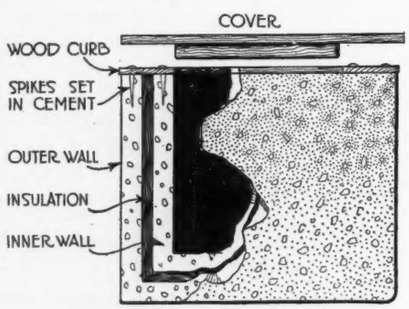
WHETHER milk is produced in the frigid climate of Maine or in the warm climate of North Carolina, ice is a factor in retaining the sweetness of the products in the creamery. A liberal use of ice not only insures a wholesome product but will curb the development of bacteria.

New England, as well as Southern, dairymen squander thousands of dollars annually because of poorly cooled milk and cream. Since 85 per cent of all milk and cream sold from farms in the United States is produced where natural ice is available, it is only a question of methods, in cooling, storing and shipping milk. Hence, an insulated concrete tank, as described herewith, is not only satisfactory but is inexpensive, as it can be equipped within the farmer's own domain.

The walls of the tank should have a total thickness of from 8 to 10 in. The outer shell should be a 2 to 4-in. wall of concrete. Next to this is placed a 2-in. layer of insulating material and then an inside concrete wall of 4 in. thickness.

Here is the proper mixture for the concrete: one part Portland cement, two parts of clean, sharp sand, and four parts broken stone or gravel. Hydrated lime, equal to 10 per cent by weight of the cement, should be added to the mixture for the purpose of making the tank waterproof. Construct the outer wall first, then set the insulation in hot asphalt or gas-house tar and coat its inner surface with the same material. Permit the substance to dry thoroughly before the inner wall of concrete is built. The inside wall of the tank should be carefully troweled so as to force back all projecting particles of stone or gravel.

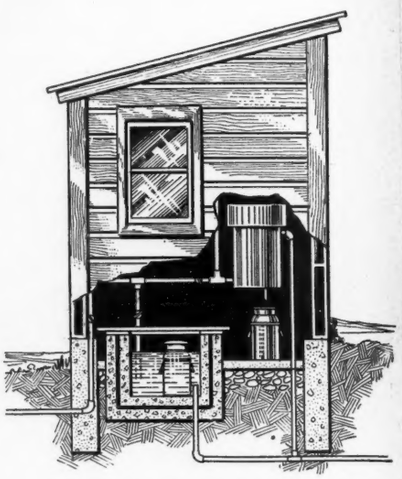
When constructing the tank, if built partly underground, as described in the



Inexpensive to build, cement forming the greatest part of this tank

illustrations, an outside form extending only from the surface of the ground to the top of the tank is necessary. However, when the tank is constructed altogether above ground, a complete outside form is essential. After the outside forms are in position pour 4 ins. of concrete into the bottom. On this concrete set the inside form, leaving a space of from 2 to 4 ins. between the forms, depending on the thickness of the outside walls. After the concrete has set, remove the inside form and coat the inside walls and floor with hot asphalt or tar. The sheets of insulation should be coated with the same material and put in place on the floor and against the walls, care being taken to make all joints tight.

After the insulation is in place cut down the inside forms, previously



The completed tank is shown in detail in the cutaway illustration above

used, to a size that will provide a 4-in. space between the walls and forms. The form should be set into place and blocked up 4 in. above the floor, and the concrete for the inner walls and floor should be poured in at one operation. The wooden curb around the top of the tank should have twenty penny spikes driven into the underside at frequent intervals and the curb set in place and pressed down so as to embed the spikes into the concrete before it sets. If the inner surface of the walls is rough upon removal of the forms, a coat of cement mortar should be applied.

The size of the tank should be gauged by the output of milk on the farm. With the flow of milk varying from season to season and from year to year, the construction of a tank in two parts is suggested, the larger being approximately twice the size of the smaller. The cooling tank not only retains the sweetness of the cream but protects the product from dust, flies and other contaminating influences. The milk house is the best location for the tank and 50 degrees Fahrenheit, or below, is the desirable temperature.

A can of cream placed in ice water in such a tank will remain sweet for several days, while milk will keep for a much longer time. On a structure of this kind depends the dairyman's success.

The Standard Spark Plug of America

CARBON PROOF—more power—less gas

Put a Set of AC Carbon Proof Plugs in your Ford, Overland, Studebaker or Tractor—They Clean Themselves

Equip your car or tractor with a full set of AC Carbon Proof Spark Plugs, and do away with all your carbon troubles.

The better quality of porcelain in these plugs stops breakage and current leakage. Consequently, a bigger, hotter spark is delivered, which makes your motor run more smoothly, stops its missing, and makes it quicker on the pick-up.

With a set of these Carbon Proof Plugs in your car, you may advance the spark all the way without the motor knocking. Thus with a smaller throttle opening you get more power, better performance, and lower gasoline consumption.

AC Carbon Proof Spark Plugs are specially designed for Overland, Ford and Studebaker cars. They are also built for tractors.

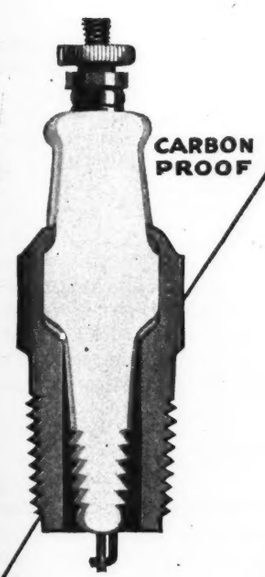
Install a set of these plugs today. They cost no more than ordinary spark plugs.

No matter what car you drive, there is an AC Spark Plug specially designed for it. Glance through the list of manufacturers below. They have been using AC Plugs for standard factory equipment for years.

During the war all Liberty and Hispano-Suiza airplane motors were equipped with AC Spark Plugs.

You may be sure that the spark plugs which best served such masters will serve you best also.

Write for The Spark Plug Story. It contains information that will prove of much value for you.



Notice the sharp knife-edged porcelain in the cross section of the AC Carbon Proof Plug here illustrated. That construction is the whole secret of this plug's success. These edges, being thin, heat rapidly. The heat burns off the carbon as fast as it forms. This is an exclusive AC design and fully covered by our design.

Champion Ignition Company, FLINT, *Michigan*

These manufacturers use AC Spark Plugs for factory equipment

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American-La France	Dodge Brothers	K-Z Trucks	Paige	Smith MotorWheel
Anderson	Dort	La Crosse Tractors	Pan-American	Standard Trucks
Apperson	Duesenberg Motors	Lalley-Light	Paterson	Stearns-Knight
Appleton Tractors	Eagle Tractors	Lane Trucks	Patriot Trucks	Sterling Motors
Avery Tractors	Essex	Liberty	Peerless	Sterling Trucks
Brockway Trucks	Federal Trucks	Liberty Aircraft Motors	Phianna	Stewart Trucks
Buffalo Motors	F-W-D Trucks	Locomobile	Pierce-Arrow	Straubel Engines
Bugatti	Gabriel Trucks	Marmon	Pilot	Stutz
Buick	Genco Light	Master Trucks	Pioneer Tractors	Sullivan Trucks
Cadillac	G. B. S. Motors	Maxim Fire Trucks	Premier	Swartz Lighting Plants
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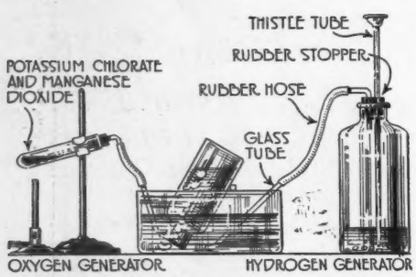
Chicago Trucks	Hatfield	Mitchell	Rock Falls	Vim Trucks
Cole	Haynes	Moline-Knight	Rowe Trucks	Ward La France Trucks
Commonwealth	Herschell-Spillman	Moreland Trucks	Rutenber Motors	Westcott
Conestoga Trucks	Hispano-Suiza	Napoleon Trucks	Samson Tractors	White
Continental Motors	Howell Tractors	Nash	Sandow Trucks	Whitney Tractors
Crane-Simplex	Hudson	National	Saxon	Wilcox Trux
Daniels	Hupmobile	Nelson	Scripps-Booth	Wisconsin Motors
Davis	Jackson	Nelson & LeMoon Trucks	Scripps Motors	Wolverine Tractors
Deere Tractors	Jordan	Netco Trucks	Seagrave Fire Trucks	
	Jumbo Trucks	Northway		
	Kissel Kar	Oakland		

U. S. Pat. No. 1,135,727, April 13, 1915, U. S. Pat. No. 1,216,139, Feb. 13, 1917, Other Patents Pending

Making Fireworks at Home

By Floyd W. Darrow

ALTHOUGH the old-fashioned Fourth of July celebration with commercial fireworks has been largely banned, there is no reason why even greater fun should not be had with pyrotechnic materials prepared in the home laboratory. All the fire and thunder, that formerly punctuated the outbursts of youthful patriotism on this red-letter holiday, may still be



This mixture ignites with a loud report, and very considerable shattering force

enjoyed, and at the same time valuable chemical information may be acquired. *Note that in carrying out the experiments here described the utmost care must be exercised.*

Phosphorus and Potassium Chlorate

To start your celebration with the proper amount of noise, the following demonstration will provide the ammunition. Place on a brick or anvil a *very little* powdered potassium chlorate (as much as you can get on the point of a penknife). Then pour over this one or two drops of a strong solution of yellow phosphorus in carbon disulphide. When the carbon disulphide has evaporated, leaving phosphorus in a finely divided state throughout the potassium chlorate, a very sharp explosion will result. Should the explosion be slow in coming, strike the mass with a hammer held in the gloved hand; but do not, under any circumstances, touch it with the fingers.

To make the solution of phosphorus, transfer, by means of pincers, a piece of phosphorus about the size of a pea to a small stoppered bottle containing a few cubic centimenters of carbon disulphide, and shake for a few moments. Always keep phosphorus in water, and never touch it with the fingers unless it is underneath water. To cut it, place the stick in a basin of water and use a sharp knife.

Spontaneous Combustion

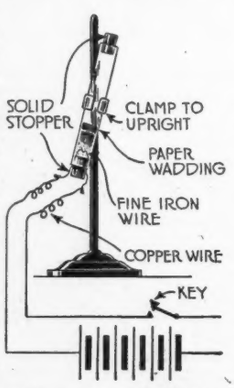
Pour a little of the solution of phosphorus in carbon disulphide, used in the previous demonstration, over a piece of absorbent paper, and taking it in the fingers wave the paper back and forth through the air for a few minutes. As soon as the carbon disulphide has evaporated the phosphorus will ignite and the paper will burst into flame.

Old-Fashioned Gunpowder

Mix thoroughly 30 grams of finely powdered potassium nitrate with 5 grams each of powdered charcoal and flowers of sulphur. Place the mixture on a square of asbestos and ignite with a long wax taper.

A Small Cannon

A cannon can easily be made in accordance with the accompanying diagram. Secure an 8-inch length of heavy glass tubing, about one half inch in diameter, and fit the ends with solid cork or rubber stoppers. The butt-end stopper should fit a little more tightly than that at the muzzle, and, passing about it so as to be buried in the powder, insert a short loop of fine No. 28 iron wire. In the tube place a half-inch layer of gunpowder, and tamp it down with paper wadding. Connect the ends of the iron wire with a key and half a dozen dry-cells. Then clamp the tube and contents securely to an upright support, and press the key. The electric current will heat the iron wire to incandescence and ignite the powder. If carried out at night or in a darkened room, a brilliant flash of light will fill the tube and issue from its mouth.



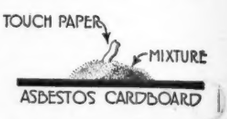
Only a harmless flash issues from this instrument, and it can be made to appear like its big brother if properly dressed

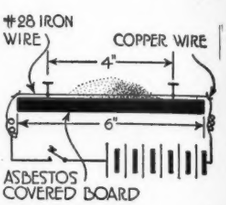
Touch-Paper

For use as fuses in several of the succeeding experiments a quantity of touch-paper will be desirable. This can be made by saturating strips of unsized paper in a concentrated solution of potassium nitrate and allowing them to dry. When ignited the combustion will slowly proceed until the whole paper is consumed and the fire cannot be extinguished by blowing.

Red Fire

Finely powder one gram of potassium chlorate and eleven grams of strontium nitrate *separately*. (*They must not be powdered together*). Then make a mixture of the chlorate and nitrate together with 4 grams of flowers of sulphur and ½ gram of lamp black. Place the mixture on an asbestos card board or paper and ignite with a long wax taper or by inserting in the heap a fuse of touch-paper. An intensely red flame results and one of great brilliancy in a darkened room.





You cannot blow out this flame, once it is started

Green Fire

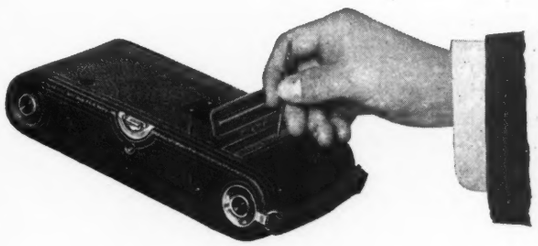
Mix as before 3 grams of finely powdered potassium chlorate, 8 grams of finely powdered barium nitrate and 3 grams of flowers of sulphur. Place the mixture on asbestos and ignite with a taper or short fuse of touch-paper.

Purple Fire

Finely powder and then mix 2 grams of copper sulphate, 2½ grams of flowers of sulphur and 15 grams of potassium chlorate. Ignite on asbestos with touch-paper or taper.

White Fire

Mix equal quantities of powdered potassium chlorate and magnesium dust. Place the mixture on asbestos and ignite with a *long* taper. Do not try to light it with a match. An instantaneous flash of dazzling brilliancy results.



The date on the Film

In just a few years you will ask:

This picture of John, was it made before or after the war? And this of little Mary taking her first toddling steps—how old was she then?

How those snap-shots, made on our trip to the Yellowstone bring it all back to us, except the date,—when *did* we go?

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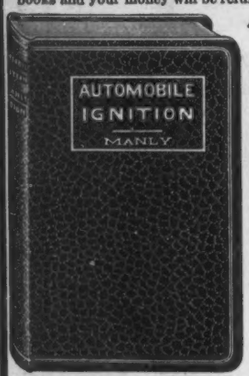

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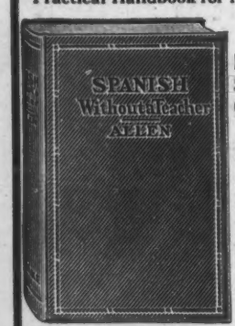

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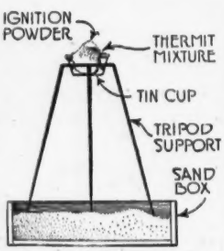
Ignition by Electricity

A novel way of lighting any combustible mixture is by means of electricity. Cover a six-inch square of wood with asbestos paper and drive into it two nails four inches apart. Between the nails taking a turn around each one insert a piece of No. 28 iron wire and on it place the mixture to be ignited. Connect the ends of the wire with 6 or 8 dry cells and close the circuit. The wire is heated to incandescence and the combustion follows.

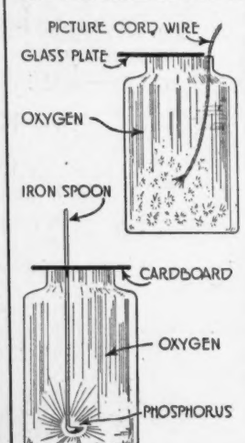
Nitrogen Iodide

A nitrogen compound of extreme sensitiveness can be made from the reaction of iodine and strong ammonia water. In the bottom of a test tube place a few cubic centimeters of the strongest ammonia and add an equal volume of concentrated tincture of iodine. The tincture can be made by shaking crystals of iodine with a little alcohol. When the ammonia and iodine solution are mixed nitrogen iodide immediately separates in the form of a black powder.



This mixture ignites with a blinding display of light and streams of molten iron flow into the tray of sand

Nitrogen iodide is not at all explosive when in solution, but is very explosive when dry, and only a very small quantity is necessary to demonstrate its great instability and explosive nature. Therefore shake up the contents of the test tube and pour successive small quantities on folded filter papers. Allow these to dry, which will take at least an hour.



The flame equals a flash of lightning in its brilliancy. It is accompanied with feathery sparks

When dry tickle one portion with a long feather and even this gentle friction will cause it to explode with a sharp report.

One of the papers held with tongs and suddenly depressed over a Bunsen flame will explode with sufficient violence to extinguish the flame.

Blow upon another portion through a long glass tube and the sudden puff of air will cause the iodide to explode.

Always make these explosions at long range and never leave any of the explosive lying about.

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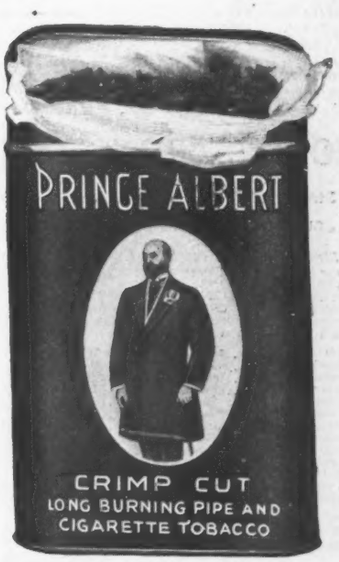

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Thermit

One of the highest temperatures known to science and a brilliant pyrotechnic display can be obtained from a mixture of iron oxide and aluminum dust known as thermit. Mix equal quantities of red iron oxide (ordinary rouge) and aluminum dust. Fill a small tin cup with the mixture and in a little depression in the top place some of the flash powder used in the white fire experiment. Now mount the cup over a sand box and ignite with a long taper. A blinding display of light follows and streams of white-hot molten iron melt through the bottom of the cup and flow into the sand bath beneath. The temperature obtained here is 3000° C.

Explosion of Oxygen and Hydrogen

Set up oxygen and hydrogen generators as shown in the diagrams. To prepare oxygen place in the generating test tube a mixture of potassium chlorate and manganese dioxide. With the stopper and delivery tube inserted heat the mixture very gently with a bunsen burner or alcohol lamp and collect the gas in a bottle filled with water and inverted in a pan of water as shown. When one-third of the water has been displaced remove the delivery tube and displace the remainder of the water with hydrogen gas. To prepare the hydrogen gas place a small quantity of zinc in the bottom of a generator and through the thistle tube pour dilute sulphuric acid. The sulphuric acid is prepared by pouring very slowly one part by volume of the acid into six parts of water. (*Never pour water into the acid*). After allowing the generator to work for about two minutes so as to drive out the air place the delivery tube underneath the mouth of the partly filled bottle and displace the rest of the water.

Now, lifting the bottle, mouth downward, quickly insert a solid rubber stopper carrying about it a short loop of No. 28 iron wire. Place the bottle under a small wooden box covered in turn with a larger box, the latter being raised about an inch from the table on small blocks. Connect the iron lead-in wires with 6 or 8 dry cells and close the circuit. The mixture immediately ignites with a loud report and the inner box is usually shattered.

Burning in Oxygen

Collect several bottles of oxygen as described in the previous experiment, and slipping glass plates beneath their mouths remove them from the water. In one of the bottles burn iron picture cord wire. Unravel one end of a six inch length and heating the fibers dip them in a little powdered sulphur. The sulphur will melt and cling to the wire. Ignite the sulphur by placing in the flame and immediately thrust into a bottle of oxygen. A very rapid

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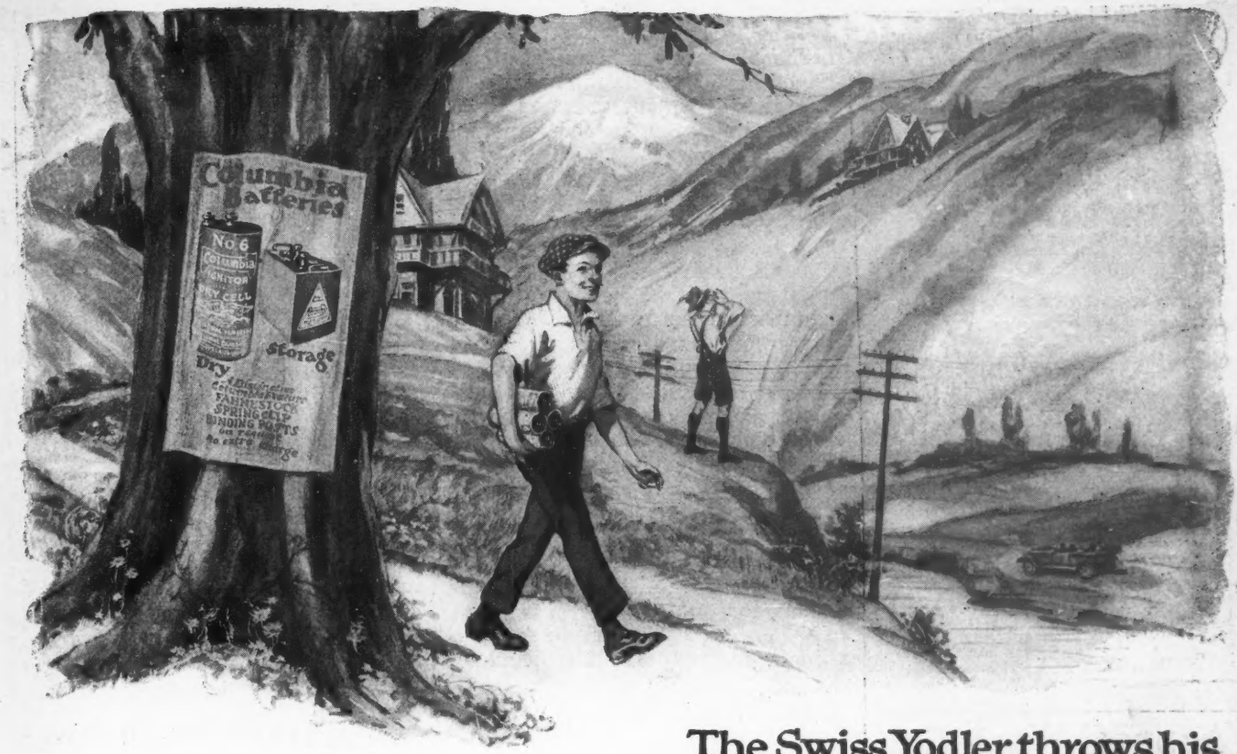

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combustion will follow, accompanied by the radiation of a multitude of brilliant sparks. In a darkened room the effect is much heightened.

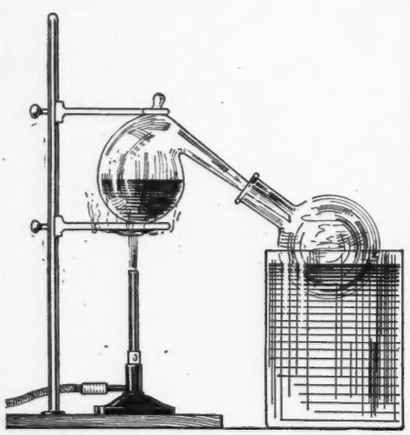
In the bowl of an iron spoon ignite a little red phosphorous and thrust into a bottle of oxygen. A white light of dazzling brilliancy results.

Combustion of Sugar and Potassium Chlorate

Carefully mix without friction equal quantities of finely pulverized potassium chlorate and cane sugar. Saturate a small piece of asbestos paper with concentrated sulphuric acid and, holding it with tongs, drop it on the mixture placed on asbestos paper. A very rapid combustion results accompanied by an intensely blue flame.

Nitric Acid

The fundamental requisite for the manufacture of explosives is nitric acid. From the black gun-powder of a century ago to the nitrocellulose,



Great care should be taken with this experiment, as the acid will burn anything it touches

picric acid and T.N.T. of present day warfare, nitric acid has been the moving factor in high explosives.

To prepare the acid arrange a ring stand, tubulated retort and condensing flask, as shown in the figure. Place in the retort about 15 grams of sodium nitrate and by means of a funnel pour over it 10 cubic centimeters of concentrated sulphuric acid. Insert the stopper in the retort and heat the mixture very gently, using a small flame.

Very soon small drops of the acid will be seen condensing in the neck of the retort and trickling down into the flask. If the contents of the flask begin to boil remove the flame and avoid, so far as possible, the production of brown fumes. Continue the process as long as any acid distils over. The liquid collected in the flask is very strong acid and care must be exercised in handling it.

To show its oxidizing action pour a little of the acid in the bottom of the test tube and just above it place a loose plug of excelsior, cotton wool or boiler felt. Then, holding the test tube with a holder, heat the acid until

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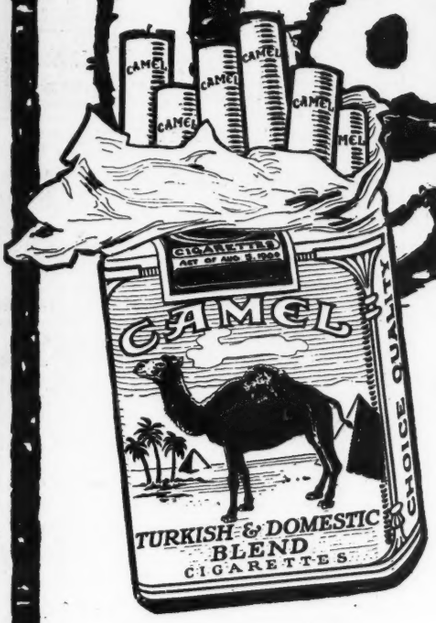

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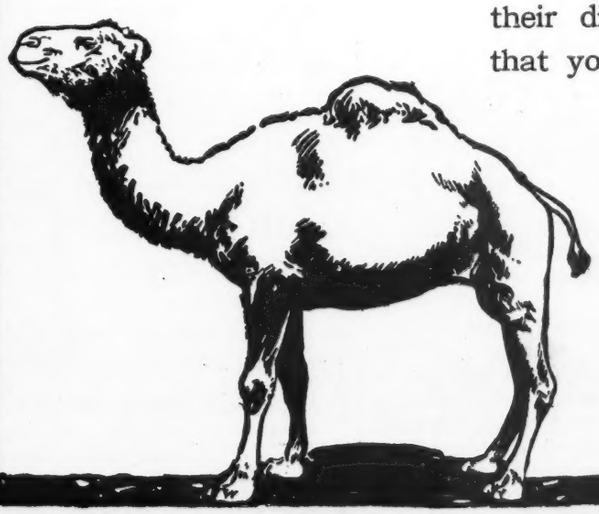

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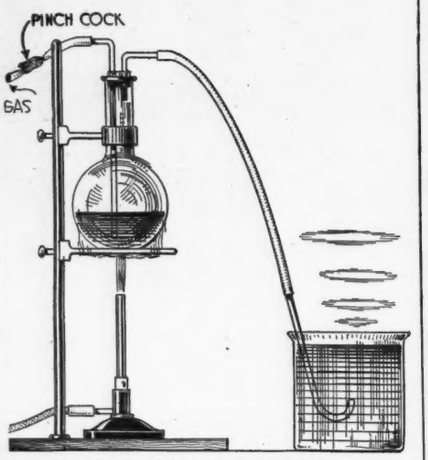
it boils. As the hot vapor comes in contact with the combustible plug the latter will spontaneously ignite.

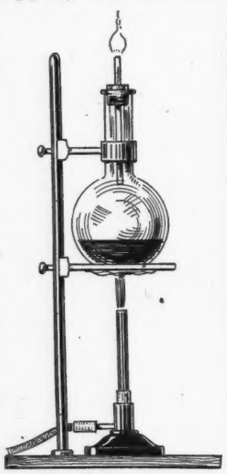
Combustible Gas Rings

A very striking and pretty demonstration of spontaneous combustion may be carried out as follows: Arrange apparatus as shown in the diagram. In the flask place about



As the bubbles rise they form a wreath of smoke of peculiar effect

300 cubic centimeters of a strong solution of sodium hydroxide and introduce two or three small pieces of yellow phosphorus. (*Do not hold the phosphorus with the fingers. Handle it with pincers.*) Then pass ordinary illuminating gas through the flask to expel the air. To do this connect the bent glass tube dipping beneath the solution with a gas cock by means of rubber tubing.

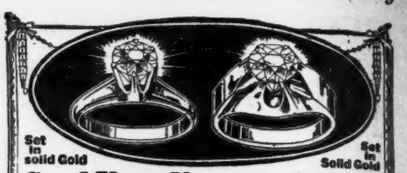


The steam that issues from the tube is luminous

Now gradually heat the flask and contents with a Bunsen flame. When near the boiling point a gaseous compound of hydrogen and phosphorus, called phosphine, begins to form, and as each bubble of the gas escapes from the water into the air it spontaneously ignites. In so doing each bubble forms a wreath of smoke which expands as it rises, giving a very striking effect.

Phosphorescent Vapor

In a small flask, fitted with a one-holed cork stopper and a short piece of straight glass tubing, place 20 cubic centimeters of water and a phosphorus match-head or small piece of phosphorus. Heat to boiling, and the steam will be luminous in a darkened room.



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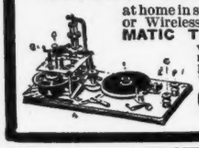

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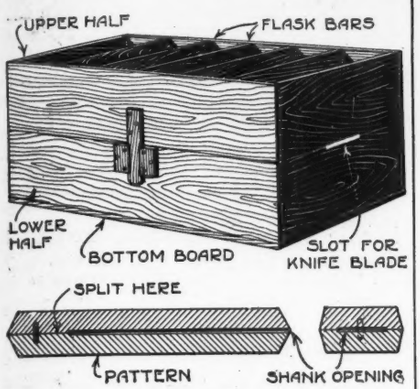

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Next in importance is the handle pattern. This may be made according to the taste of the mechanic, either round, square, or odd shaped. The handle pattern shown in the drawing is to be made of soft pine, split as shown into two parts. These parts should be doweled together near the edge. The center of each half should be hollowed out to fit the shank of a knife.

Now obtain a couple of quarts of moist earth from the garden and sift it to remove all foreign matter, pebbles, sticks, etc. Before using make it moist enough to stick together when squeezed into a ball with the hand. It should not be wet because if it is the molten aluminum will not stay in the mold when it is poured. A small quantity of dry river sand is needed to separate the halves of the mold; this is called parting sand. A short piece of stick ¼ in. round, called a gate, completes the equipment for molding.

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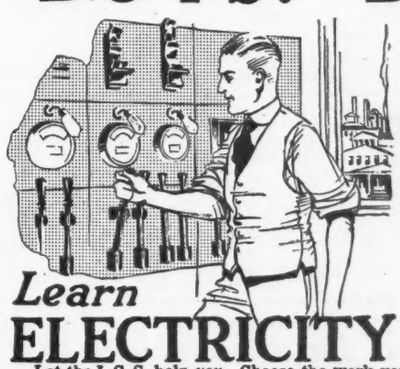

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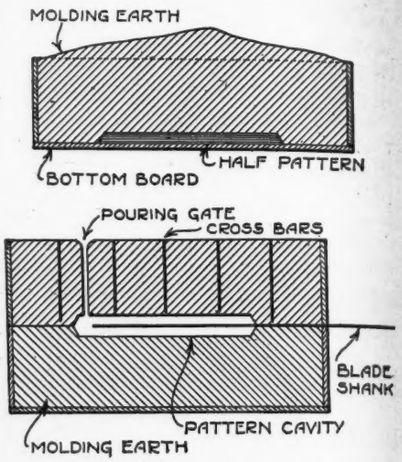
The melting apparatus consists of a common blow torch and a small babbitt ladle, or the metal may be melted in any stove or furnace at home. When the equipment is ready the first step is to remove the old handle from the knife. Then heat the shank red hot to burn out any moisture or grease. Sometimes it is well to have the shank of the knife hot when casting the metal.



A sectional view of the mold, showing how the aluminum is poured into it

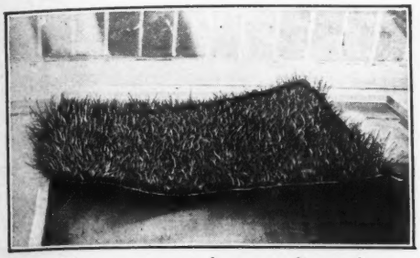
The molding is done thus: place the nowel half of the pattern on a bottom board and place the nowel or lower half of the molding flask around it. The slotted end of the pattern should be towards the slot end of the flask. Fill the half box with the moist earth; press it firmly in and pat it down, but not too hard because the metal boils in hard molds, spoiling the casting. After the half flask is filled, level it down and place another bottom board on it. Then turn the whole thing over and remove the first bottom board. Blow away any loose dirt and sprinkle a thin layer of dry sand over the surface. Place the shank of the knife handle in the hollow of the pattern. On top of it fit the other half of the pattern. Now the gate stick is put in place as shown in sectional drawing of mold, and the top half of the mold is pressed full of the molding earth. It is pressed only firmly enough to hold it in place between the cross bars. The gate stick is now withdrawn and the hole made funnel-shaped at the top to receive the melted aluminum. Next the top half of the mold is raised and lifted off, the patterns are drawn and the knife blade heated and replaced. The half molds are put together again and made ready to receive the melted metal; the two halves must be clamped together, or weighted down, else the pressure of the molten metal will force the mold apart and spoil the job. The cross sectional drawing shows the way the mold should look ready to pour.

An ordinary tool box is employed to transfer the equipment from one house to another if the work is done this way.—DAVID BAXTER.

Take in Your Lawn When It Rains

WE don't mean exactly that, but some very curious mats have been produced by growing real grass on pieces of burlap. The plan is an interesting one, for whether the mats are used in a green or dried state, they are highly attractive.

The first step is to get a piece of burlap of a suitable size. This should be well moistened and placed upon a flat surface. Sow the seed somewhat



The grass mat is a novelty and adds to the appearance of the porch

thickly and give it water when needed. The seed soon germinates and where there are signs of thin places—like the bald spot on Dad's head—more seed must be sown.

If the mat is resting upon soil it must be moved about from time to time, as this will prevent the roots of the grass from going through the burlap into the soil. As soon as the grass is three or four inches in length the mat is ready for use. Contrary to what one would expect the blades of grass are not easily pulled away, so closely do they cling to the fibres of the burlap.

A charming effect is secured by using the mats in a green state. If the burlap is kept slightly moist the grass will remain fresh and green for a long time. The mat may be placed upon a piece of linoleum to prevent the slight dampness causing any damage.

To dry the mat off, it is only necessary to hang it up and give it no water. The grass turns a pretty shade of dull green and serviceable mats that will wear for a long time may be made with a little more care in the preparation of the foundation before the seed is sown.

Mats of this sort may be used in a variety of ways.—S. LEONARD BASTIN.

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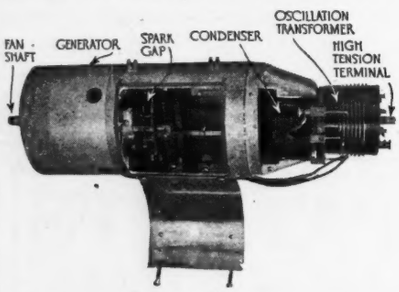
For *the* Radio Experimenter

For additional articles on radio and its developments the reader may be referred to pages 32, 35, and 83 of this issue

Radio and the NC Planes

OF surpassing interest the last few weeks has been the flight of the American naval airplanes across the Atlantic. Little has been given out as to the airplanes' radio-telegraphic and -telephonic equipment. And yet, these instruments were as important to success as the airplanes' other features—often their sole eyes and ears. POPULAR SCIENCE MONTHLY is fortunate this month in being able to present details on this exceptional radio equipment.



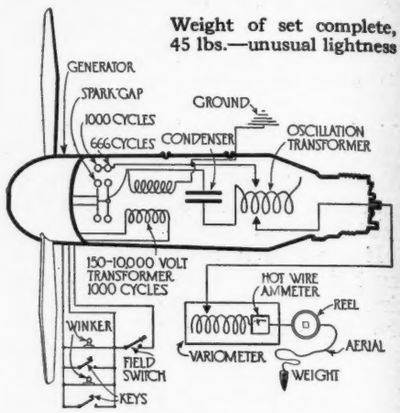
Showing the ½-kilowatt set assembled, demonstrating its compactness and accessibility. At the right are details. The winker lights "wink" when one operator is sending, signaling the helper, and vice versa. This prevents them from any interference with each other

The NC boats have two complete radio sets. One is of ½-kilowatt capacity, with a normal sending radius of 300 to 400 miles, though under especially favorable conditions this may go to 1,500 miles. The generator on this set is wind-driven. The other radio unit is operated by a compact 12-volt storage battery. With this set both radio-telegraphic and -telephonic communication may be carried on.

The sets performed remarkably at all times during the flights. At one time the Assistant Secretary of the Navy in Washington filed a message inquiring the position of one of the airplanes. Within three minutes a reply was received, uncommonly quick time. Balboa, Canal Zone, and San Diego heard also.

The battery unit is installed to permit communication when the airplane is riding on the water and the wind therefore insufficient to operate the generator on the other unit. This set's aerial is up on the skid fins of the upper wings—well out of the water at all times. The ½-kilowatt set's consists of 250 feet of wire, which trails out below and behind when the airplane is in the air, but which is reeled in upon descent.

Weight of set complete, 45 lbs.—unusual lightness



The especially prominent feature about the ½-kilowatt set is its compactness and light weight—45 lbs. Experts acquainted with the set say that this reflects unusual credit on American technique. An ordinary ½-kilowatt set used on shipboard may weigh 600 lbs. Generator, spark-

Radio Experimenters! Let's Hear from You

WITH this issue the POPULAR SCIENCE MONTHLY resumes the publication of its radio articles, now that the government permits the operation of receiving sets and promises soon to remove all restrictions.

Since the United States entered the war an industry has grown up employing several hundred thousand men in manufacturing and distributing alone, not to mention the thousands of commercial and amateur radio operators scattered over the world. Here is an audience waiting to learn of the new things in radio communication. It is the POPULAR SCIENCE MONTHLY'S purpose to give them the vital, important radio news.

Therefore, let's hear from you! If you've evolved some new radio idea you think is interesting, if you've witnessed unique processes growing up in factories producing radio apparatus, or had to do with uncommon experiments and developments, or know of noteworthy work or exploits of operators using apparatus in the field—let's hear from you!

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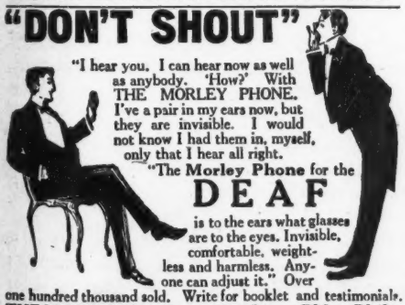

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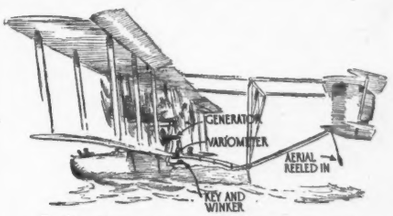
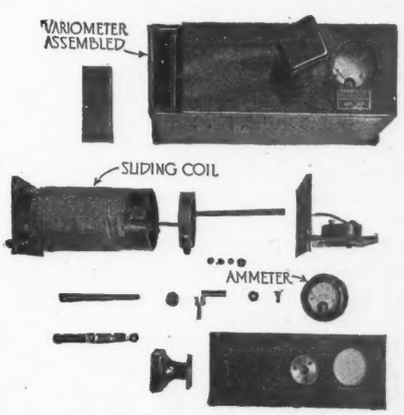
gap, transformer, condensers, and so forth, are all contained within a single stream-lined body. As is apparent from the illustration, the spark-gap has two rotors, one with twelve projections and the other with eight. Both revolve at the same rate, but one delivers 1,000 sparks a second and the



Indicating the position of the ½-kilowatt set on the NC airplanes

other 666, thus producing two distinct tones, either of which the operator may use, and which permit greater selectivity, or the choosing of the tone best able to carry through radio traffic in the region at the moment.

The diaphragm on the telephone transmitter is open front and rear, so that engine noises neutralize themselves. But the operator's voice reaches but one side, so its impulses carry through. Radio operator, pilot, navigating officer, engine man, helpers —in fact, the whole crew of five or six men—are all in intercommunication at all times by telephone, and naturally with the other planes if they happen to be within the instrument's working radius, around 20 miles. The telegraph part of the set will reach about 30 miles, though



Details of the variometer accompanying the ½-kilowatt set

of course these distances become greater or less with varying atmospheric and ether conditions as with any radio apparatus.

Within the tail of the plane, coils forming the radio compass are mounted. These are revolved at will by the operator through the aid of suitable connecting mechanism, and are most important in helping the plane locate itself with respect to ship and land stations.

The "NC" in the airplanes' names comes from "N," *Navy,* and "C," *Curtiss,* indicating the type. The number that accompanies the "NC" denotes merely numerical order.

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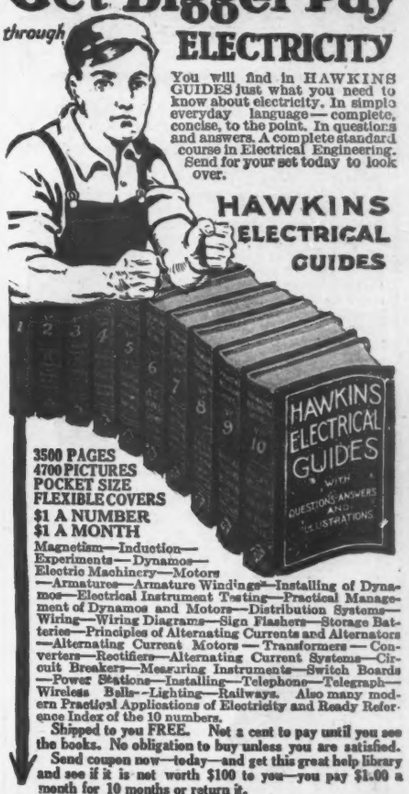

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Secret Wireless Receiving

THE advent of the electron relay or audion type of amplifier has made possible a number of useful receiving methods which were impracticable in the early days of wireless telegraphy. Among these rejuvenated ideas is that of receiving wireless messages from long distances, by means of entirely concealed absorbing antennae. With a few feet of wire strung around inside a room, it is possible to hear messages arriving from stations many hundreds of miles away, and even to determine in just what direction the transmitter lies.

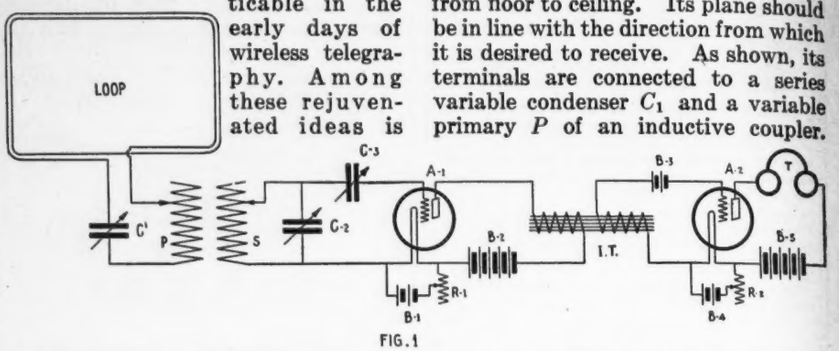

FIG. 1

With simple loop antennae, of the type shown above, concealed within an ordinary living-room, it is now possible to receive interesting messages from long distances

The U. S. Department of Commerce, at the radio laboratory of the Bureau of Standards in Washington, has been working on secret receiving devices for radio telegraphy, and the Navy Department is understood to have spent some time on similar investigations. No information has been given out as to the specific instruments used by the investigators attached to these two branches of the government, but it is generally assumed that some form of the magnetic loop antenna has been utilized. Mr. Frederick Kolster, who is the radio engineer of the Department of Commerce, is credited with the receipt of messages from Germany by the use of simple loops of wire erected within his laboratory and properly tuned.

Other inventors and experimenters have also been giving some attention to this matter of concealed receivers. At Union College, Schenectady, New York, Dr. Ernest J. Berg has tested a small, magnetically-operated receiving antenna which not only receives messages arriving from considerable distances, but also indicates the approximate direction of their travel. He has pointed out that not only can an aerial of this sort be built for much less money than a tall structure of the usual kind, but that it is effective in receiving messages through atmospheric interference which would be exceedingly troublesome with the ordinary high masts. The directive feature also helps to eliminate interference from nearby stations which are out of the imaginary line connecting the receiver and sender.

A good arrangement for experimental work of this sort is shown in Fig. 1. The large loop is made of about ten turns of insulated copper wire, about 24 gauge, strung in a vertical plane within the receiving room and with its height equal to the distance from floor to ceiling. Its plane should be in line with the direction from which it is desired to receive. As shown, its terminals are connected to a series variable condenser C_1 and a variable primary P of an inductive coupler. The secondary S of this coupler has its terminals shunted by a tuning-condenser C_2, and leads to the grid-condenser C_3, of an audion-detector A_1. The filament and plate circuit batteries, B_1 and B_2, are connected in the usual manner; the variable 10-ohm rheostat R_1 is provided for regulation of filament temperature.

The plate circuit of the audion-detector, instead of containing a pair of telephones, passes through the primary of a high resistance iron-core "Intensifying Transformer" at *I.T.* The secondary of this instrument leads to the grid of an audion-amplifier, A_2, through a grid-circuit battery B_3 which serves to keep the grid potential at the best point for amplification. The plate circuit of this amplifier contains the telephones, T; the uses of the batteries B_4 and B_5, as well as of the resistance R_2, are clearly shown by the diagram.

In adjusting the amplifying set it is usually found that critical settings of the batteries B_2, B_3 and B_5 and of the resistances R_1 and R_2 are necessary to give the best signals. To find these adjustments easily, it is most convenient to use a test-buzzer to excite the loop antenna in the usual way. If the test-buzzer is attached to a wavemeter circuit and thus produces high-frequency oscillations, not only can the detector and amplifier be adjusted, but the primary and secondary circuits can be tuned for any desired wave-length of reception.

The single loop arrangement is most effective for receiving from stations located in its plane. If two loops are set up at right angles, as in Fig. 2, it becomes possible to receive from stations located in any direction from the receiver. The diagram shows these loops of a single turn each, for the sake of simplicity. In practice they should be of ten or twenty or more turns of wire. The best number of turns to use will depend upon the wave-length being received, as well as on the area enclosed by the turns, and can best be determined by trial.

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When two loops are used, their effects may be combined on a radiogoniometer of the sort used by Bellini and Tosi. This is a somewhat complicated instrument for the experimenter to construct, however, and for preliminary work a switching scheme as shown in Fig. 3 will answer well enough. Four single-pole double-throw baby knife switches are mounted on a

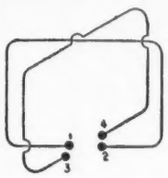

Fig. 2. Two loops at right angles enable the aerial to receive from every direction

board, and their terminals connected to the ends of the loops 1 and 2, 3 and 4, and to the primary condenser and inductance, exactly as shown. This wiring plan makes possible a number of combinations; for instance, to use the loop with terminals 1 and 2 alone, switches *A* and *B* are left open, while *C* and *D* are placed into the upper position. To use the loop at right angles alone, *C* and *D* are placed in the down position, *A* and *B* being left open. If all four switches are "up," the loops are connected in parallel in one relation; if all four are down, they are in parallel but in the inverse phase relation. To put the loops in series, leave *A* open, turn *C* down and *B* and *D* up. On examination of the diagram, still other combinations of connections will be found possible.

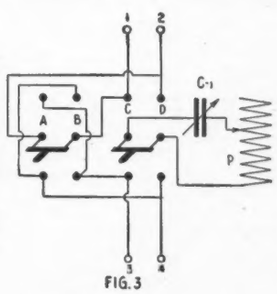

FIG. 3

Switching arrangement for obtaining best use from two-loop aerial. Many combinations are possible, permitting very wide experiment

The combination of audion-detector and amplifier is so much more sensitive than any detector used alone that even with these small loop antennas comparatively long distances can be covered. By using additional steps of amplification still better results can be obtained; and sustained waves may be received by using the heterodyne plan of generating local oscillations and combining them with the incoming signal. The detector circuit of the inductive coupler may, of course, contain a regenerating audion or any other responsive apparatus. In fact, experiments with the ordinary crystal-detector are satisfactory for short distances. In building the loops, the turns should be kept separated throughout by an inch or two, so that the capacity between them will be minimized. Thus each loop becomes a veritable tuning-coil of great diameter and short axial length.

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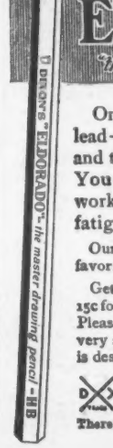

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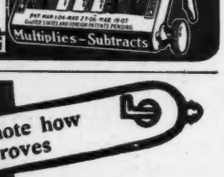

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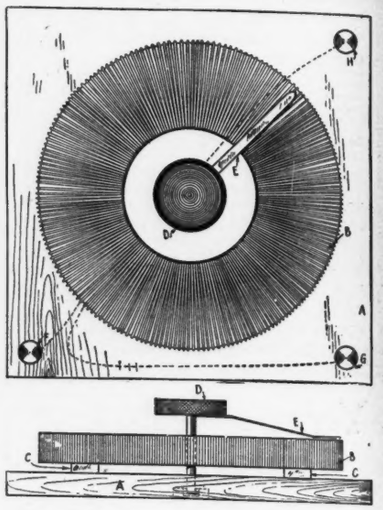
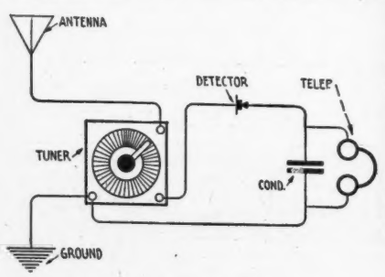
The Construction of a Rotary Tuning-Coil

FIRST a base is made of hardwood measuring 8 in. square by 1 in. thick, as shown at *A* in the illustration. A ring *B* is next sawed from 1½-in. stock, 7 in. in diameter with the rim 1½ in. thick. Shellac this ring thoroughly and while it is still tacky, wind it with a single layer of No. 23-gauge double cotton or silk-covered magnet wire. The wire must be wound tightly and the turns should



Details of rotary tuning-coil. The construction is simple, careful winding of the ring offering the greatest difficulty

be made close together. After the shellac is thoroughly dry mount the ring on the base with very small wire nails. Care must be taken not to injure the wire when securing the ring to the base. The best way to do this is to put the nails in the ring before



How the rotary tuner is connected to a typical circuit. No great changes from the ordinary are necessary

winding on the wire. The ring is raised from the base with small blocks *C*, through which the nails pass. A hard rubber or fiber knob *D* is fastened to the base as shown, so that it will turn. A contact arm *E* is secured to the knob. The insulation is burnt or scraped off with a knife where the contact arm touches the wire. The two ends of the wire are connected to the binding-posts *F* and *G*. The contact arm is connected to the binding-post *H*.

The connections are shown in the diagram. Any detector may be substituted for the crystal-detector in the diagram.—MALCOLM K. GORDON, JR.

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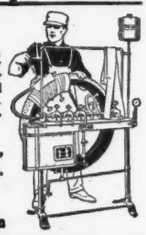

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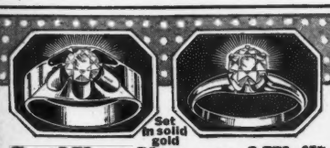

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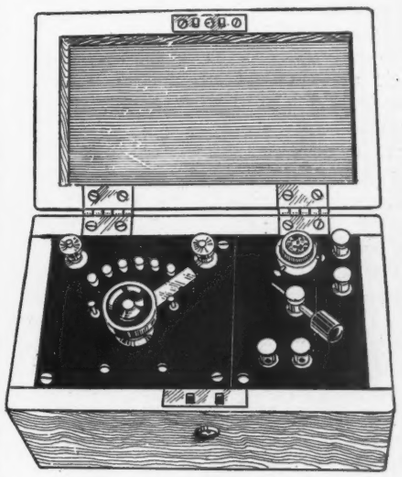

A receiver of this type combines simplicity with portability, compactness with broad range

pair of head telephones, antenna and ground connection.

When this set is used in connection with a portable antenna, which of necessity has a low capacity, it is not necessary to secure a ground connection. As a result the set may be used anywhere, regardless of the condition of the soil, or whether it be moist or dry. There are no sliding contacts or loose couplings to bother with. With a single wire antenna strung from a high cliff, rock or tree, preferably 400 or 500 ft. long, 80 per cent of the stations heard will come in stronger without a ground connection.

The first thing to be considered is the little box or case that contains the inductance, condenser and detector. It is made from ¼-in. quartered oak, the inside dimensions being 6 in. long, 3 in. wide and 2½ in. deep. The hinged cover is 1-in. deep to allow for the space taken up by the rubber knob of the inductance, the detector and binding posts, the bases of which are flush with the upper edge of the case, as shown. A small catch-lock is provided, which gives the set a neat and business-like appearance, and obviates the use of a strap to keep the case closed when held by the brass handle on cover top.

The inductance consists of approximately 140 turns of No. 22 single cotton-covered copper wire wound on a fiber or card-board tube 2½ in. in diameter and 2 in. long. A soldered connection or tap is taken off at every twentieth turn and soldered to a lug of a 7-point switch.

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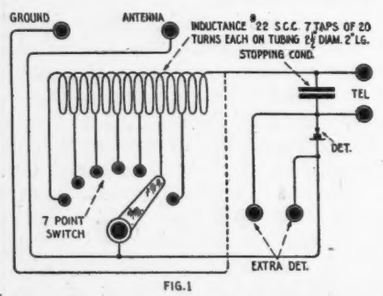
In taking taps from inductances of any description it should be noted that the turn of the coil itself should not be brought up to the lug and then back to the tube to complete the turn again. There are at least two good ways of taking taps from coils; one is to bare some of the wire on the turn for about ¼ in. and solder a separate wire to it. A second method is to double back about 5 in. of a turn, scrape bare the lower extremities and secure by twisting them together. In both cases the connection should be soldered and taped or shellacked so that the advancing taps will not short circuit back on each other. Taps of this character do not disturb the continuity of the coil nor cause undesirable capacity effects. After the inductance is finished it should be thoroughly painted with insulating shellac or varnish, especially the soldered connections.

The stopping condenser may comprise any small fixed condenser suitable for radio circuits, provided that it fits easily into the case with the inductance. One may be constructed by using 10 sheets of heavy tinfoil, or extra light sheet brass 1½ in. by 2¾ in., separated by similar sheets, slightly larger, of paraffined or oiled paper.

Connections are made as shown in Fig. 1, care being exercised in assembling the parts into the case, so that no exposed connections are in any way short circuited.



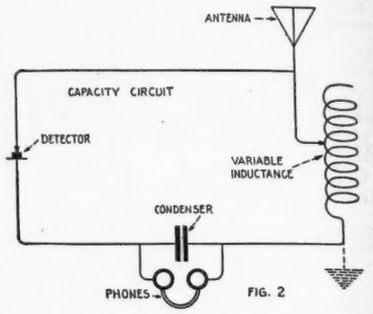
Details of the interior wirings of the portable receiving set. Use care in assembling

The detector is composed of a small silicon or galena crystal soldered in a little brass cup, which in turn may be secured in a larger cup by small set screws projecting from the side. Resting lightly on the crystal is a fine steel wire soldered to a brass rod that moves back and forth, and also turns, in a small binding-post. A small knurled rubber knob on the opposite end of the rod permits adjustment of the detector.

Two binding-posts are provided for the telephone tips, while two extra posts may be used to connect in different detectors as desired.

Referring to Fig. 2, it will be noted that the inductance, condenser and detector composes a closed circuit. This arrangement gives much the same effect without the ground connection shown by the dotted lines when used on an antenna of low capacity, such as a single wire suspended in the air. When the set is connected to a ship antenna or one of similar capacity the ground binding post should be used to get the best results; otherwise the incoming signals will be weakened.

When the set is to be used in the country or mountains, nothing more is needed than a spool of light, flexible



Schematic representation of the portable receiver connected to a typical circuit

wire and the telephones. To obtain a good height for the antenna, tie a stone to one end of the wire, then swing the weighted part up into the top of a high tree and lead out wire for 400 or 500 ft., securing it to a stick or some convenient support before connecting to the antenna binding post.

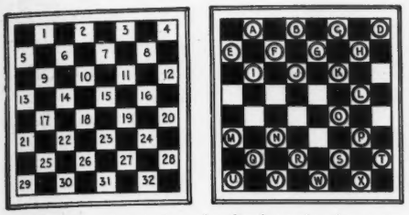
Connect the telephones and set the switch on the second or third point. Adjust the detector several times. It should not be long before signals from distant stations are heard.

In case a ground connection becomes desirable a very excellent one can be obtained by driving a new 8-penny nail into the side of a living tree, near the ground, and leading a wire from this to the set. The roots of the tree are full of moisture and extend in all directions, in many instances deep into the earth. The writer obtained very good results with this little portable instrument on the Southwestern coast of Mexico, where the character of the country is extremely barren and rocky. A single wire was stretched from a rocky pinnacle about 200 ft. high, down to the edge of a small lagoon. Signals from the United States at night were clear and strong.

Amateurs in all sections of the country are finding that the vacuum valve type of detector, or rectifier of electric waves, is permitting them to do many things impossible in the old days. The valve, properly adjusted, is so much more sensitive than crystal detectors, and is capable of so much wider performance, that they find much of interest in rigging up vacuum tubes to take the place of, and compare with, crystal detectors. The extra detector binding posts on this set are convenient for experiment along this line. They enable typical vacuum valve circuits to be arranged and then connected in on this portable receiving set without disturbing the existing wiring on the apparatus. Amateurs will probably enjoy affixing other features to the set to add to its flexibility.—STANLEY E. HYDE.

Playing Checkers by Wireless

AN amusing method of playing checkers, which, by the way, is highly instructive in learning wireless operation, is to provide two complete sets of checkers and boards with the spaces numbered and the men lettered as shown in the illustration. When



Now comes the checkerboard wireless, which is highly instructive for beginners and amusing to anyone

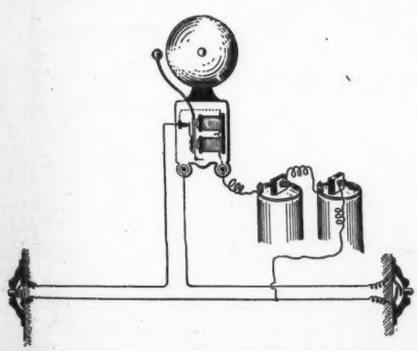
the apparatus is adjusted, one player takes the men from *A* to *L* and the other player from *M* to *Z*.

The first player telegraphs "Move *L* from 12 to 16," whereupon both players make the move. Then the other player might telegraph "Move *O* from 23 to 19." Both move then "Jump *L* from 16 to 23, etc.," until the end of the game is reached. It is very evident that the game may be interposed with telegraphic exclamations thus making interesting practice.

This scheme may also be used with telephone or ordinary telegraph. Or it may be played by a bed patient unable to sit at a table, who may call the moves from one bed to another.—VICTOR TODD.

One Bell with Two Push-Buttons

WHEN one electric bell is used to indicate calls from two different places, such as the front and back doors of a dwelling, it is rather difficult to determine the source of the call.



Two push-buttons on one bell is an old trick, but one that few amateurs know

This can be remedied by connecting, as shown in the diagram, where one button causes the bell to act as a single stroke bell and give one tap on the bell every time the button is pressed.

The other button will give the regular trembler action.—THOMAS W. BENSON.

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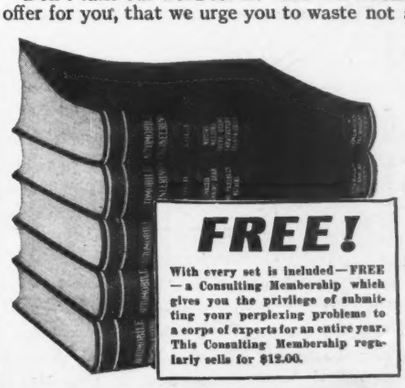

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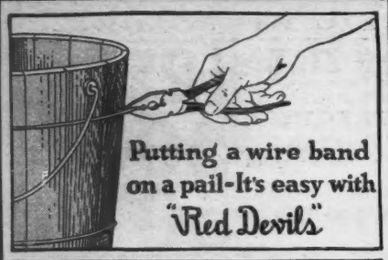

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That Canvas Camp in the Woods

By George M. Petersen

CANVAS houses are often referred to as tents, but nothing is further from the truth. A canvas house, properly speaking, is a wood frame or skeleton over which is stretched canvas to keep out the weather. The house shown in the illustration is nearly ideal both as to size and comfort.

Do you remember those happy days when you had that camp? Why don't you have another this summer? Here it is. Get busy right now

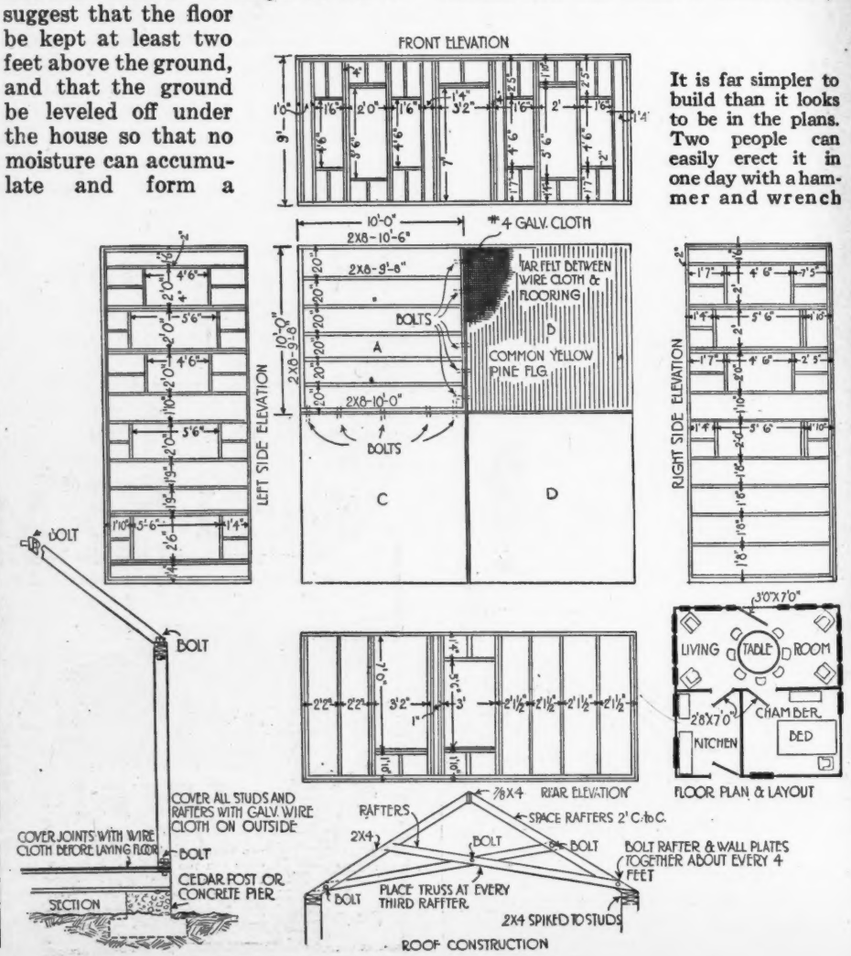
The floor for this house is made in four sections, each section being ten feet square to facilitate handling. Each section is complete in itself, and the four parts are bolted together as shown to form the floor of the house.

The joists are first framed together as in *A*, and are then covered with 14-mesh galvanized-wire cloth or screening to prevent mice, squirrels, and other small animals from boring up through it. A layer of tar felt could be laid over the screening to good advantage, and it would assist greatly in keeping out small gnats, mosquitoes, and other insects. It might be well to suggest that the floor be kept at least two feet above the ground, and that the ground be leveled off under the house so that no moisture can accumulate and form a breeding-place for insects. Level ground, plenty air, and cleanliness around the house will do much to keep away all kinds of pests.

The floor should be supported upon posts or concrete piers, and these should be level across the top so that the entire floor rests evenly upon them.

The walls are then constructed in sections, as shown in the drawings, each section being bolted to the floor and to each adjoining section, so as to make the building rigid and strong. Each wall section should be covered with 14-mesh or finer galvanized screening put on the outside of the studs. By covering the walls of the entire house with screening the canvas may be rolled up once or twice a week and the whole house aired without any trouble.

For the window spaces it is well to use 22- or 24-mesh wire cloth. This fine mesh screen will turn even the hardest rain and make it unnecessary



It is far simpler to build than it looks to be in the plans. Two people can easily erect it in one day with a hammer and wrench

to close the canvas windows. Such a screen also insures freedom from the little insects that come through the ordinary 14-mesh window-screen.

Finishing the Roof

The roof is framed as shown in the roof construction drawing, the rafters being securely spiked to plates both at the ridge and at the eaves. Provision is made for bolts to draw these sections together, first at the ridge and then to the wall plates. The tops of the walls are prevented from spreading by the truss which is bolted to every third rafter. It is well to cover the rafters with screening also, as it greatly saves the canvas by taking the strain off it between the rafters, preventing the canvas from being cut by their rough edges.

When the rafters are in place and the tarpaulin drawn over the roof, the floor should be given at least two coats of good lead and oil paint to preserve the wood and also to assist in keeping the house dry. This paint should be put on thin and well brushed in if it is to be of any value.

The Canvas Cover

The canvas covering should be made in five sections—front, rear, left and right sides, and roof. Each wall-section covering is secured to the top wall plates by means of screw-hooks, and stretched down to the bottom wall plates, where it is secured in the same manner. The window openings are cut out and flaps are sewed on to make the two window coverings about six inches larger each way than the openings. The wall covering is buttoned down around the window openings, so that the wind will not get behind it and tear it.

The flaps covering the windows are also made to button down in case of a big storm or when greater privacy is desired. After all of the wall-section coverings are in place, the roof covering is stretched tight, and lapped at least a foot down over the side walls to prevent rain from beating in from underneath. The roof covering is usually fastened down over the side-wall covering with buttons or screw-hooks.

The front and rear doors, and the inside doors as well, may be regular screen doors covered with a canvas flap, which may be rolled up or left down as the case may be. The interior partitions can be easily framed to suit individual taste, and may be covered with canvas or wall-board. As this type of building is readily taken down, there is no reason why the inside of the walls should not be covered with a good wall-board, except that it will prevent the proper airing of the building.

This whole house, with the exception of the piers, perhaps, can easily be placed in a large van or truck and taken back to the city when the vacation period is over.

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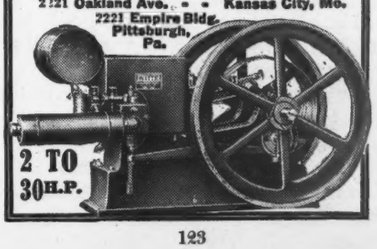

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How to Improve the Intake Manifold

By George B. Gould

DID you ever stop to realize what constitute some of the important problems of the present day gas engineer in his efforts to perfect this means of power and locomotion, or have you thought of what has been done toward solving the problems of the gas engine in its progress toward present day perfection? Through this constant striving toward perfection we have seen the evolution of the quiet sleeve valve and the sixteen valve head. Here are the efficient valve and the sufficient valve capacity. If the two could be combined we might, perhaps, be able to rest on our laurels.

If, however, we are given a valve or valves of sufficient size to permit enough gas to enter the cylinder on the down stroke, we must next consider, how we are going to get enough gas to the valves. Accordingly I wish to draw your attention to the intake manifold and what may be done toward its perfection on the small, as well as the large gas engine.

Tumbling three manifolds at one time. Power supplied from overhead shafting

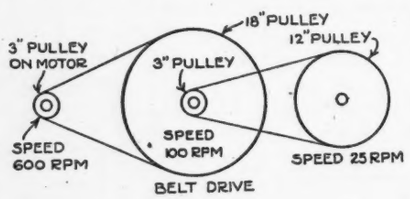
It has been repeatedly remarked—and proven—by engineers connected with the manufacture of airplane engines that the tumbling operation—or the smoothing of the inside surface of the intake manifold on the airplane engine—tends toward a positive increase in speed of from five to ten per cent. In view of this it is logical to deduce that the tumbling operation will be of great benefit to the Ford intake manifold and ultimately to the Ford engine.

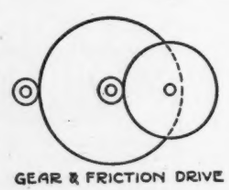
The intake manifold, as it is cast and comes from the foundry, is very rough and uneven on the inside, and this roughness greatly impedes the progress of the explosive gases on their way toward the valves and the cylinder. Shoot the gases into the cylinder and you will get a snappy and responsive engine. If you have a large valve area and an improper sized or a very crooked and rough passage for the gases to be drawn through, you simply create eddies in the manifold and your increase in speed and power is not very great. But in the tumbling operation you increase the size of the passage through the intake manifold, and, what is still more important, you do away with the obstructions that arrest the speed of the mixture in its journey toward explosion.

Like an old man sighs for the youth that is gone, so the motorist sighs for the "pep" and accelerating ability that the motor had when new. In the tumbling operation we have a simple and first-class method of increasing the motor's power.

There are some who will say without thinking: "Why not increase the size of the intake manifold to a greater extent?" But you will readily see that this will not do, because the minute you increase or decrease the size of the manifold to any appreciable extent you thereby lessen your throttle control of the motor. You must remember that you want your motor to slow down under the operation of the throttle lever just as fast as it picks up. To illustrate this, imagine an extra large diameter intake manifold on your motor and the throttle open for a quick getaway on low gear; your large manifold fills up with an explosive mixture and that's all very well. Right away you are ready to slow the engine down to shift into high. You close the throttle, only to find the engine keeps on turning over rapidly until it has used up the large supply of gas in the extra large manifold. The result is you either slip your clutch or there is a considerable lapse of time before you can shift into high, and both are undesirable to the average motorist.

Tumbling two manifolds with a mixture of sand, jagged iron or steel. 30 to 60 R. P. M.

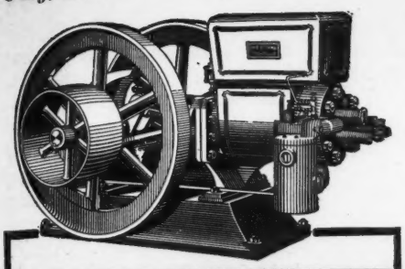




How the drive speed is increased or reduced. Two different kinds of drives illustrated

Much the same as the human machine is this present-day gas engine in that the better you enable each to breathe the better and faster each will run. Clear your throat now and see how much better you breathe, and tomorrow clear out the obstructions in the Ford's intake manifold and see how much better it will breathe—and run.

But how do we go about clearing the inside of the intake manifold? What does this much-talked-of tumbling operation consist of? It consists in the main of taking one or more intake manifolds, filling them half full of a mixture of sand and pieces of jagged iron or steel choppings, fastening them securely to a large wooden disk and



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then revolving this disk at a very slow speed for, say, twenty-four hours. During this time the particles tumble and keep working around through the manifold until the inside surface becomes as smooth as the proverbial bald head. All the roughness and the small obstructions that impede the progress of the gas are thereby done away with. We have a better manifold by far and a motor with greater accelerating ability—a motor that will give you a maximum of speed and distance. It is surely worth trying.

For the Small Car Owner

I would like to see garages and Ford service stations adopt this method of helping the Ford owner for a small consideration and to the benefit of all concerned. It can be done if the garage or service station has any kind of stationary engine. A small gas engine, or electric motor, or even water power is not to be overlooked in performing the tumbling operation.

First you must rig up the large wooden disk to which the manifolds are secured. The size of this disk varies according to the number of manifolds you may wish to tumble at one time, and as little as ⅛ horsepower is sufficient to revolve it at the necessary speed of about thirty revolutions a minute.

The manifolds, as you will notice from the illustration, are fastened to the disk by means of wooden cleats and one bolt per manifold, after the mixture of sand and broken glass or sharp pieces of iron or other metal have been placed therein. Only one bolt per manifold is necessary where an even number of manifolds are fastened to the disk to be tumbled at one time, as it is possible to bolt the carburetor openings of two manifolds together. By this means you also close these openings. The other two or upper openings are closed by bolting this side against the disk, thus preventing the loss of any of the mixture during the operation.

To Tumble Three Manifolds

Where one wishes to tumble three manifolds at one time and where the shafting may have to go through the center of the disk, it is necessary to nail three projections of wood to the face of the disk, and then bolt the carburetor openings of the manifold to this projection, having the upper holes against the disk as mentioned above, and held against it by the wooden cleat and a long bolt.

The above, of course, is simply a basis to work on, but it contains all the necessary data for improving the intake manifold by tumbling. You know better than anyone else the material and power you have handy and can undoubtedly improve on the above method in some of its minor details.

If your stationary engine or other

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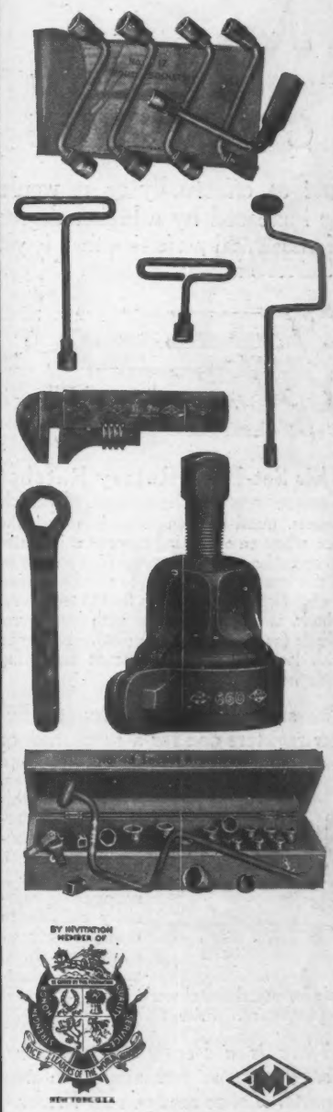

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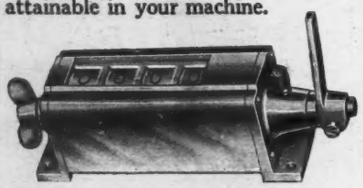

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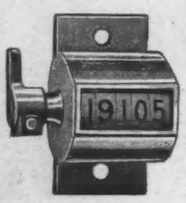

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source of power moves or revolves at a speed of, say, 600 revolutions per minute it will be necessary to reduce the speed by using large and small pulleys to effect a reduction in speed of the disk to about 30 revolutions per minute. For instance, a 3-in. pulley, turning at a speed of 600 R. P. M. revolves an 18-in. pulley at only 100 R. P. M., the driven or 18-in. pulley being six times as large as the driving pulley and therefore moving at only one-sixth the speed of the driving pulley.

Suppose you now want a further reduction from 100 R. P. M. to 25 R. P. M. Simply place another 3-in. pulley on the same shaft as the 18-in. pulley and make this 3-in. pulley revolve a 12-in. pulley by means of suitable belting. The 12-in. pulley will revolve at the required 25 R. P. M.

The same principle holds true in the use of spur gears as a means of transmitting or reducing the revolutions of a motor.

Good on All Makes

Do not make the mistake, however, that that which is good for the intake is likewise good for the exhaust manifold, as getting rid of the exhaust gases involves no engineering problem worth mentioning. It is, as remarked before, the intake manifold—the inhaling of the explosive mixture—that the present-day gas engineer principally concerns himself with. The two most important factors in the perfect manifold are the absence of too sharp corners or bends, and in the smoothness of its inside surface.

While I have repeatedly mentioned the Ford manifold in connection with the above, it is equally true that the tumbling operation works wonders with any manifold, no matter on what make of gas engine it may be. It is not outside the realm of possibilities to infer that the time will come when all the intake manifolds will be smoothed during manufacture, or else some live service station will make a business of improving manifolds in this manner.

Modern Ways

Nowadays there are many garages which find use for some motive power, generally to operate a small lathe or other machinery, and in instances of this kind the proprietor could easily install the tumbling apparatus. A small air pump could also be run from the same shafting as the other machinery.

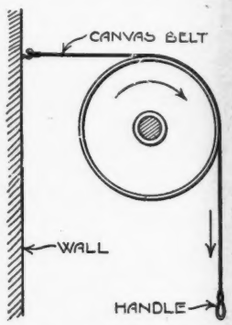
A tank would be filled with compressed air during the time that the other machinery in the garage was being used, and then from this tank the customers would be furnished free air. The proprietor would also be saved time and labor in connection with the vulcanizing and assembling of tires and tubes.

By grouping apparatus in this way it would be not only possible, but lucrative, to furnish service to the owner of Ford and other cars in the matter of "tumbling" intake manifolds.

To facilitate and expedite the service even more it would be possible for the garage owner to purchase a few second-hand or new intake manifolds, tumble them, and have them all ready to install, thus saving time and the possible laying up of the car. Again, there are many car owners who would be only too glad to have this smoothing and perfecting of the intake manifold done while the car is being overhauled.

A Brake for the Spinning Counter-Shaft

IN common machine-shop practice, counter-shafts and similar power transmitters are allowed to spin when the belt is thrown off for any reason, and many accidents have occurred from trying to stop them with a bare hand. As a consequence a machinist devised the following simple method by which such accidents could be easily prevented and the spinning stopped when desired.

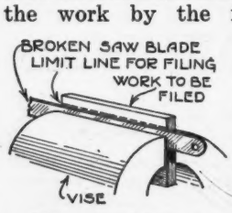


Simply pull the handle and the shaft will stop

A short section of canvas or leather belting is suspended over the countershaft pulley, so that the end hanging down touches the pulley on a side opposite to the direction of its rotation. A suitable handle is attached to its lower end. A slight pull on the belting will stop the spinning pulley in a few seconds with absolutely no danger.—L. B. ROBBINS.

An Old Hack-Saw Used as a Guide for Filing

WORN-OUT or broken hack-saw blades should not be thrown away. They can be used for guides when filing articles to a straight and even line without danger of destroying the work by the file accidentally slipping past its desired point.



How the blade is attached to the vise

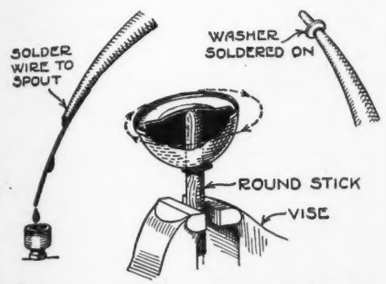
Mark off the work at the required point and place the hack saw blade against the piece of work so that it follows the line evenly at both ends. Clamp work and blade into a vise, being very careful that the blade doesn't slip.

You can then proceed to file without any danger of going past the line.—THEODORE GATHMAN.

Things You Should Know about an Oil-Can

THE illustrations offer three ideas worth knowing about oil-cans. The first one shows how to adapt a short-spout oil-can to oiling places just out of ordinary reach. A piece of stiff wire is soldered along the spout so that the oil, pouring from the spout, will run along the wire on to the part being oiled.

The second idea is the application of a washer to the oil spout to prevent



As usual, it's the little things that count, and help you to economize

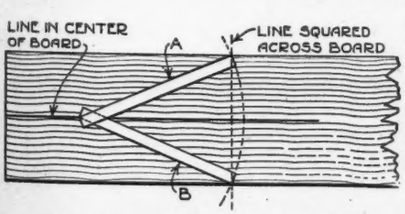
it jamming. The washer prevents the spout from entering too deeply into the oil hole.

The third is a method of reviving the tension of the spring at the bottom of an oil-can. A round-topped stick is held in the vise and the oil-can inverted upon it as shown. While pressing down, revolve the can. This will force the bottom upwards, thus giving it new life.—CHARLES H. WILLEY.

Squaring a Board without a Square

IT sometimes happens that you want to square up the end of a board but haven't a square with which to do it. In a case like this you can lay off a square end in the following manner.

Make a mark along the exact center of one end of the board as shown in the sketch. Then lay one end of a ruler or yardstick upon the mark and



Squaring without a square is simple if you keep this idea in your mind

touch the other end of the ruler to one edge of the board, making a mark at that point. Then swing the end of the ruler across to the other edge and make a similar mark there.

Connect these two marks with a straight line and the board can then be cut directly upon this line and will be found exactly square when sawed.—L. B. ROBBINS.

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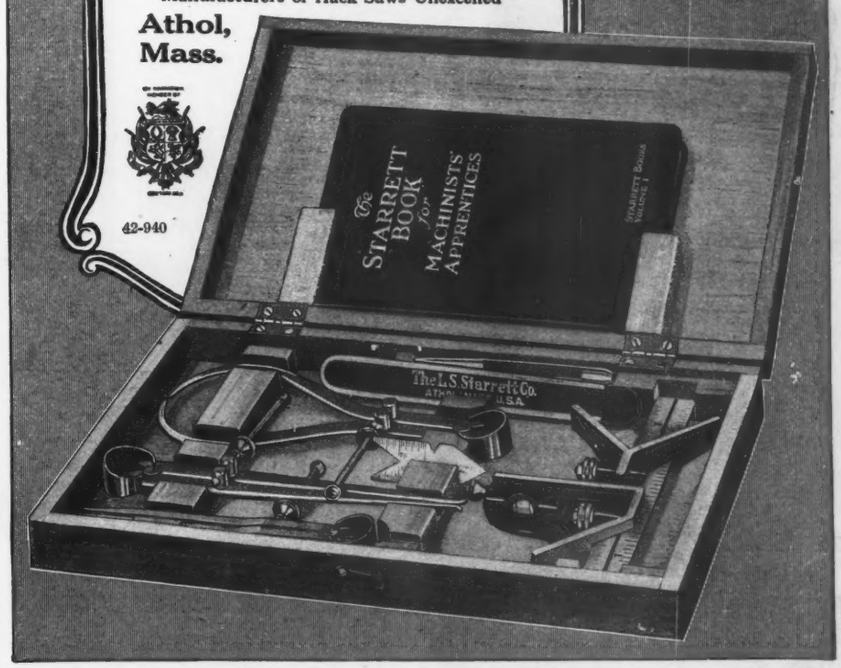

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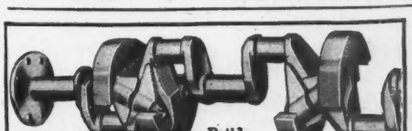

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